YITP Annual Report

Yukawa Institute For
Theoretical Physics
Kyoto University

2010

Foreword

We present here an annual report of the scientific activities of Yukawa Institute for Theoretical Physics during the academic year 2010.

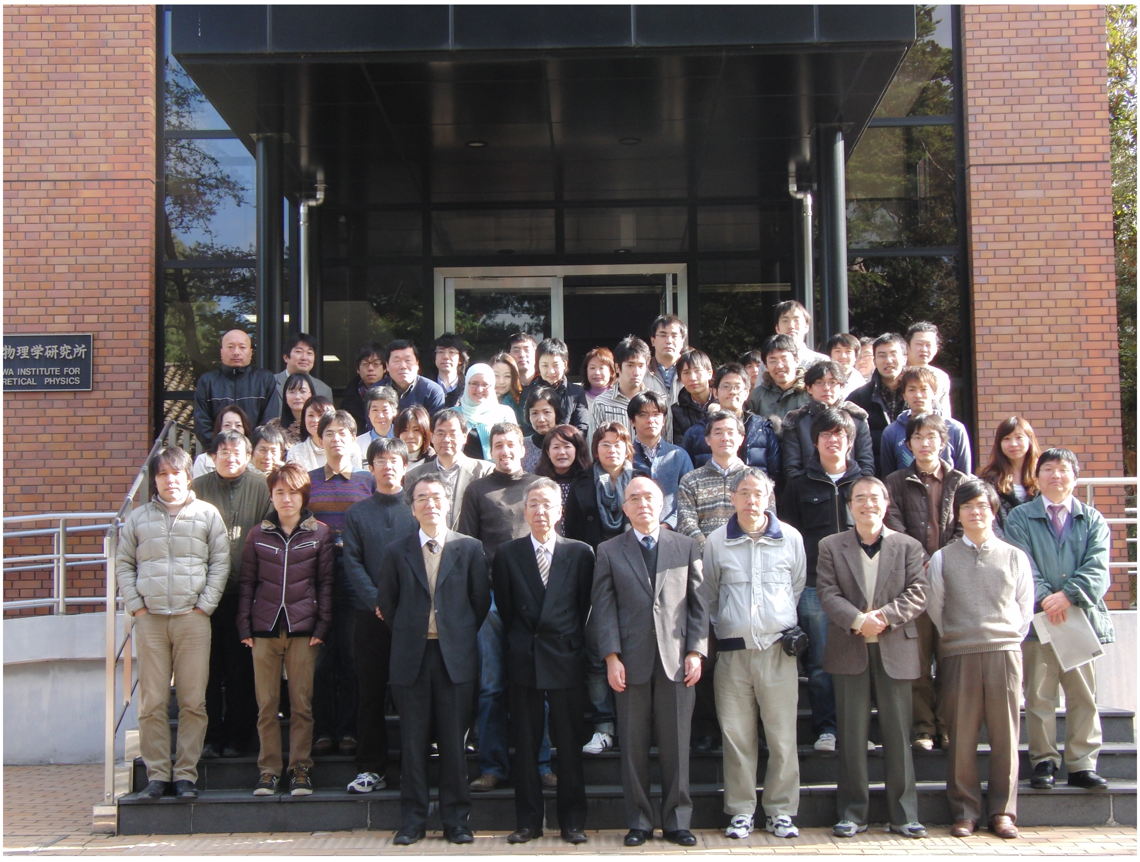
From the year 2007 we started our new project of “Yukawa International program of Quark-Hadron Sciences (YIPQS)” funded by Japan Ministry of Education, Culture, Sports, Science and Technology. In this project we select a few research topics each year for long-term workshops and invite leading experts from abroad to stimulate discussions and foster collaborations among workshop participants. In the year 2010 we held two long-term workshops on “Gravity and Cosmolog” and on “High Energy Strong Interactions - Parton Distributions and Dense QCD Matter -”, and extensive discussions have been exchanged. Our report contains some of the results obtained during these workshops.

Director
Taichiro Kugo

Contents

Chapter 1

People



4 January 2011

1.1 Regular Staff and Guest Professors (2010 April – 2011 March)

Regular Staff

Tohru Eguchi
Professor (E)

Hisao Hayakawa
Professor (C)

Ken-ichi Shizuya
Professor (E)

Taichiro Kugo
Professor (E)

Misao Sasaki
Professor (A)

Takami Tohyama
Professor (C)

Takahiro Tanaka
Professor (A)

Akira Ohnishi
Professor (N)

Masaru Shibata
Professor (A)

Ryu Sasaki
Associate Professor (E)

Masatoshi Murase
Associate Professor (C)

Hiroshi Kunitomo
Associate Professor (E)

Naoki Sasakura
Associate Professor (E)

Keisuke Totsuka
Associate Professor (C)

Shigehiro Nagataki
Associate Professor (A)

Ken-iti Izawa
Associate Professor (E)

Naoyuki Itagaki
Associate Professor (N) [2010.4.1 –]

Fumihiro Takayama
Associate Professor (E) [2010.4.1 –]

Kenji Fukushima
Associate Professor (N) [– 2010.9.30]

Kazuo Hosomichi
Associate Professor (E)

Takao Morinari
Assistant Professor (C)

Daisuke Jido
Assistant Professor (N)

Seiji Terashima
Assistant Professor (E)

Hirofumi Wada
Assistant Professor (C)

Yuko Fujita
Project Manager

Takayuki Muranushi
Assistant Professor (A) [2010.4.1 –]

In this list, the symbols A, C, E and N in the parenthesis are the following abbreviations of research fields:

A: Astrophysics and Cosmology
C: Condensed Matter and Statistical Physics
E: Elementary Particle Theory
N: Nuclear Physics Theory

Visiting Professors

Prof. Su Houng Lee
(Yonsei University)
2010.4.1 — 2010.6.30
Exotics in QCD

Prof. Ewan Davidson Stewart
(KAIST)
2010.6.7 — 2010.8.17
After thermal inflation

Prof. Loriano Bonora
(SISSA)
2010.10.1 — 2010.12.31
Searching analytic solutions of SFT

Prof. Serge A. Brazovski
(LPTMS, Université Paris Sud)
2010.10.1 — 2010.12.31
Theoretical study of electronic and optical properties of low-dimensional correlated electron systems

1.2 Research Fellows and Graduate Students (2010 April – 2011 March)

Research Fellows

Norichika Sago (A) [2010.4.1 –]

Alberto Martinez Torres (N) [2010.3.10 –]

Shigetoshi Sota (C) [2010.4.1 –]

Isao Kishimoto (E) [2010.4.1 – 2010.11.30]

Mamoru Matsuo (C) [2010.4.1 –]

Naoki Yoshioka (C) [2009.4.1 – 2011.3.31]

Shunichiro Kinoshita (A) [2009.4.1 – 2011.3.31]

Yasuyuki Hatsuda (E) [2010.4.1 –]

Antonino Flachi (A) [2007.10.1 – 2010.9.30]

Masato Taki (E) [2010.4.1 –]

Kenta Kiuchi (A) [2010.2.1 –]

Takashi Hiramatsu (A) [2010.4.1 –]

Norihiro Tanahashi (A) [2010.4.1 – 2010.8.31]

Yoo Chul-Moon (A) [2010.4.1 – 2011.3.31]

Takatoshi Ichikawa (N) [2009.4.1 –]

Takenori Furumoto (N) [2010.4.1 –]

Eiji Kaneshita (C) [2009.4.1 – 2011.3.31]

Takashi Shimomura (E) [2009.10.1 –]

Graduate Students

Koji Azuma (E) [2009.4.1 –]

Masahiro Ikeda (C) [2009.4.1 –]

Kouki Ishimoto (C) [2009.4.1 –]

Koki Nakata (C) [2009.4.1 –]

Soichiro Isoyama (A) [2009.4.1 –]

Yuusuke Kourai (A) [2009.4.1 –]

Kazuyuki Sugimura (A) [2009.4.1 –]

Youri Doeleman (A) [2009.4.1 –]

Kazuhiko Kamikado (N) [2008.4.1 –]

Manabu Sakai (E) [2008.4.1 –]

Shingo Mizuguchi (E) [2008.4.1 –]

Kazuya Misao (A) [2008.4.1 –]

Hirotada Okawa (A) [2007.4.1 –]

Maiko Kouriki (E) [2007.4.1 –]

Kentaro Tanabe (A) [2007.4.1 –]

Yuichiro Nakai (E) [2007.4.1 –]

Atsushi Naruko (A) [2007.4.1 –]

Tatsuhiro Misumi (E) [2007.4.1 –]

Takahiro Himura (C) [2007.4.1 –]

Takanori Sugimoto (C) [2007.4.1 –]

Sugure Tanzawa (A) [2005.4.1 –]

Masaki Murata (E) [2006.4.1 –]

Noriaki Ogawa (E) [2006.4.1 –]

Daisuke Yamauchi (A) [2006.4.1 –]

Junichi Aoi (A) [2006.4.1 –]

Hiroyuki Yoshidsumi (C) [2006.4.1 –]

Kuniyasu Saitoh (C) [2008.4.1 –]

Tetsuya Mitsudo (C) [2006.7.1 –]

Koutarou Kyutoku (A) [2007.4.1 –]

Moto Araki (C) [2010.4.1 –]

Takayasu Sekihara (N) [2010.4.1 –]

Takashi Nakano (N) [2010.4.1 –]

Tsubasa Takahashi (E) [2010.4.1 –]

Tomotsugu Takahashi (A) [2010.4.1 –]

Masahiro Nozaki (E) [2010.4.1 –]

Naofumi Hama (E) [2010.4.1 –]

Hirotsugu Mitsui (E) [2010.4.1 –]

Kiyoshi Kanazawa (C) [2010.4.1 –]

Wataru Eguchi (C) [2010.4.1 –]

Koudai Sugimoto (C) [2010.4.1 –]

Kiyotaka Yoshida (C) [2010.4.1 –]

Ph.D Awarded

Kuniyasu Saitoh
Studies of Nanoclusters' Collision -Depositions on a Crystalline Surface and Graphene, and Negative Restitution Coefficient of Nanoclusters (C)
(supervisor: Hisao Hayakawa)

Tetsuya Mitsudo
The Kink Dynamics and the Large Deviation for the Current in the Asymmetric Simple Exclusion Process with Open Boundary Conditions (C)
(supervisor: Hisao Hayakawa)

Mitsuhisa Ohta
Classification of Supersymmetric Solutions in Supergravity (E)
(supervisor: Hiroshi Kunitomo)

Junichi Aoi
Exploring the Gamma Ray Bursts from GeV-TeV spectra (A)
(supervisor: Shigehiro Nagataki)

Noriaki Ogawa
Holographic Dualities in Extremal Black Holes — On the Kerr/CFT Correspondence — (E)
(supervisor: Tohru Eguchi)

Masaki Murata
No-ghost Theorem and Gauge Fixing Problem in Open Superstring Field Theory (E)
(supervisor: Taichi Kugo)

Daisuke Yamauchi
Cosmic Microwave Background from Cosmic Strings/Cosmic Superstring (A)
(supervisor: Misao Sasaki)

Affiliate Members

Kenichi Matsuyanagi

Masako Bando

Kunihiko Terasaki

Satoshi Matsuda

Mihoko Toya

Chapter 2

Research Activities

2.1 Research Summary

Astrophysics and Cosmology Group

Inflation and Early Universe

A. Naruko and M. Sasaki proved the conservation of the curvature perturbation on large scales for a generic single-field inflation model. The proof involves only the scalar field equation if it contains only first derivatives of the metric, while the gravitational equations have to be invoked as well if it contains second or higher derivatives of the metric.

T. Tanaka, with Y. Urakawa, addressed the infrared (IR) divergence problem during inflation and showed that the IR divergence is an gauge artifact at least in the single-field inflation. Then they noted a subtle issue on the gauge-invariance in connection with the choice of the initial vacuum state.

M. Sasaki, with Y. Takamizu et al., formulated nonlinear super horizon curvature perturbations in single-field inflation to second order in spatial gradient expansion, that is, beyond the δN formalism, and applying it to a specific model found that a large non-Gaussianity can be generated even on super horizon scales.

CMB and Large Scale Structure

D. Yamauchi, Y. Sendouda, C. Yoo, M. Sasaki and collaborators developed an analytic method to calculate small angle cosmic-microwave background (CMB) spectra due to the cosmic (super-)string network. They found that the amplitude of the spectrum increases as the intercommuting probability. As a consequence, strings with smaller intercommuting probability are found to be more tightly constrained.

C. Yoo and his collaborators studied spherically symmetric inhomogeneous dust cosmological models in which the observer is at the symmetry center. They showed that the SNIa observation and the acoustic peaks in the CMB spectrum can be fitted such models without dark energy, but the kinematic Sunyaev-Zel'dovich effect on the CMB anisotropy excludes such models unless one introduces a non-adiabatic perturbation at the time of decoupling. They also argued that the redshift drift of an off-center source is the key discriminator of the inhomogeneous cosmology.

Mathematical Relativity

S. Kinoshita and K. Tanabe, with T. Shiromizu, studied asymptotic flatness and asymptotic symmetry at null infinity in arbitrary dimensions. Using the Bondi coordinates, they obtained the asymptotic behavior of gravitational fields at null infinity and clarified the asymptotic symmetry there. It is also found that the Bondi mass loss law via gravitational radiations is well-defined in both odd and even dimensions.

High-Dimension Numerical Relativity

Since a possibility of black hole formation in particle accelerators was pointed out, studies for black holes (BHs) in higher-dimensional spacetimes have been accelerated. Because BH is a general relativistic object, the unique approach for clarifying its dynamical nature is numerical relativity. H. Okawa, K. Nakao, & M. Shibata performed a numerical-relativity simulation of high-velocity BH collision in 5 dimensions, and found that in the close encounter of the two BHs, a domain composed of extremely large curvature, for which the curvature scale is smaller than the Planck scale, could be formed. This implies that the properties of the BH collision/scattering in higher-dimensions could be entirely different from those in four dimensions.

Gravitational Self-Force

N. Sago, with L. Barack, developed a time-domain code for calculation of the gravitational self-force (GSF) on a point mass in bound orbits around a Schwarzschild spacetime. In collaboration with L. Barack and T. Damour, he found a good agreement between the GSF effect on the periastron advance and that predicted by the post-Newtonian method. They also proposed a way to develop an analytical model of coalescing binaries with the GSF data and the effective-one-body formalism.

Simulation for Supernova Explosion

Y. Suwa and his collaborators developed a numerical code, which solves the axisymmetric hydrodynamics with the neutrino radiative transfer, and performed simulations of core-collapse supernovae. They obtained a weak explosion driven by the neutrino heating process in axial symmetry. In addition, they investigated the effect of the stellar rotation on the explosion and found that the rotation could enhance the efficiency of neutrino heating and lead to the larger explosion energy.

Collapse of Massive Stars and Gamma-Ray Bursts

Y. Suwa, with K. Ioka, investigated the generation of gamma-ray bursts (GRBs) by a massive Population III stars. They estimated the mass accretion rate into a central black hole and calculated a jet propagation in the envelope of the massive star simultaneously. As a result, they found that even massive Population III stars, which were not candidates of progenitors because of their massive hydrogen envelope, could produce GRBs thanks to their long accretion timescale.

Collapse of Rotating Stars to a Black Hole in

Numerical Relativity

Massive stars of sufficiently high initial mass eventually collapses to a black hole (BH). If the progenitor star has a large angular momentum, the resulting system will be a rotating BH surrounded by a massive disk. Such a system is proposed as the most promising candidate for the central engine of GRBs. To explore this phenomena, Y. Sekiguchi and M. Shibata developed a numerical-relativity code in which microphysical effects of high-density matter and neutrino cooling effects are incorporated for the first time. They performed a long-term simulation for stellar collapse of very massive star to a BH and surrounding disk, and found that the disk is massive and high-temperature enough for emitting a large amount of high-energy neutrinos.

To extend this study further, M. Shibata, K. Kiuchi, Y. Sekiguchi, and Y. Suwa also developed a new formulation of neutrino-radiation transport. Y. Sekiguchi started implementing this new formulation in his code.

MHD Simulations in Numerical Relativity

Neutron stars in nature are usually strongly magnetized, and subject to a variety of magnetohydrodynamic (MHD) instabilities. K. Kiuchi & M. Shibata with S. Yoshida performed numerical-relativity simulations for neutron stars with purely toroidal magnetic fields. They found that such neutron stars are unstable against Parker and Taylor instabilities, inducing a turbulent motion. The resulting magnetic field configuration is not stationary unless another mechanism different from purely MHD ones for stabilization is present.

M. Shibata, Y. Suwa, and K. Kiuchi with K. Ioka also performed numerical-relativity simulations for rapidly and differentially rotating magnetized neutron stars that are possible outcomes after the merger of binary neutron stars. They found that a strong Poynting flux is emitted due to the differential rotation and the typical magnetic luminosity is 10^{47} ergs/s for the magnetic-field strength 10^{13} G and rotational period ~ 1 ms.

A GRMHD Code for Gamma-Ray Bursts

It is still unknown how the central engine of long GRBs is working. One of the most promising scenarios is a collapsar model: A fast rotating black hole is born at the center of a massive star as a result of gravitational collapse, and then a relativistic jet is launched from the black hole with a help of magnetic fields. Then the jet is observed as a GRB. Since the dynamics of collapsars is complicated, it is necessary to perform realistic numerical simulations of collapsars by supercomputers. In the simulations, strong gravitation and magnetic fields have to be treated properly. S. Nagataki has succeeded to develop a two/three-dimensional General Relativistic Magneto-hydrodynamics code in the fixed Kerr spacetime that is tuned so that it is applicable to supercomputers.

Ultra-High Energy Cosmic Rays

Ultra-High Energy cosmic Rays (UHECRs), whose energy amounts to 10^{20} eV, are one of the most mysterious ones in astronomy and astrophysics. It is still unknown where they are produced. Recent observations tell us that the composition of UHECRs is hadronic. Especially, the Pierre Auger Collaboration reported that the transition from proton to iron is seen at highest energy. A. Calvez, A. Kusenko, and S. Nagataki proposed a new idea to explain this feature as well as the energy spectrum of UHECRs. They proposed that these observations can be explained if we assume that GRBs had happened in Milky Way at every 10^5 yrs, because light nuclei (proton) will escape in a short timescale while heavy nuclei (iron) remain due to their large rigidity. Their paper is published in Phys. Rev. Lett., and is introduced at the homepage of GCOE of graduate school of science, Kyoto Univ. as well as IPMU and UCLA.

Very High-Energy Gamma-Rays from GRBs

It is proved by Fermi Satellite that GRBs can emit very high-energy (GeV) gamma-rays. From these observations, it is suggested that the bulk Lorentz factors of the GRB jets are as large as ~ 1000 so that such high-energy gamma-rays do not suffer from gamma-gamma interactions. However, it is assumed in this logic that the emission region is one zone. J. Aoi, K. Murase, K. Takahashi, K. Ioka, and S. Nagataki reported that the bulk Lorentz factors of GRBs do not have to be so high when we consider multiple emission regions. They showed that the observed GeV spectrum can be explained well by performing Monte-Carlo simulations of internal shock models by assuming their bulk Lorentz factors are much lower than 1000. Further, they concluded that TeV gamma-rays can be also emitted from GRBs, and the next-generation GeV-TeV gamma-ray telescope, CTA, can detect such TeV gamma-rays as long as the TeV gamma-rays do not suffer from electron-positron productions by the interaction with CMB/EBL. Their paper was accepted for publication in The Astrophys. J.

Double Neutron Star and Black hole-Neutron Star Binaries

The final phase of compact binary systems composed of neutron star (NS) and/or black hole (BH) is among the most promising source for kilo-meter-size laserinterferometric gravitational-wave detectors. The merger of NS-NS or BH-NS binaries is also a likely progenitor of the central engine of short GRBs. To accurately predict gravitational waveforms in the late inspiral and merger phases of these binaries as well as to clarify the merger process for studying the merger hypothesis of the short GRBs, it is necessary to solve Einstein's equation as well as the HD/MHD equations taking into account a realistic microphysics for NSs. The unique theoretical approach to this issue is numerical relativity, in which all these equations are solved numerically. K. Kiuchi, K. Kyutoku, Y. Sekiguchi, & M. Shibata performed numerical simulations for NS-NS and BH-NS binaries in the framework of numerical relativity changing mass and equations of state for a wide range. For NS-NS binaries, they clarified the dependence of gravitational waveforms on the equations of state and masses of NSs, in particular for the case that a BH is formed after the merger. For BH-NS binaries, they performed numerical simulations for a variety of equations of state with nonspinning and spinning BHs and quantitatively clarified that gravitational-wave frequency at the onset of tidal disruption of NS depends strongly on the equation of state. These imply that detection of gravitational waves will lead to constraining equations of state of nuclear matter. For the case that NS is tidally disrupted, a disk of mass ~ 0.01–$0.4 M_\odot$ may be formed. The formed BH-disk system was shown to have a favorable property for the short GRB.

Condensed Matter and Statistical Dynamics Group

Advanced Statistical Dynamics

The subjects of advanced statistical dynamics are nonequilibrium statistical mechanics, nonlinear sciences and biological physics. The main goal in this field is to understand how dynamical nonequilibrium structures are sustained in nature based on tools of statistical physics. Thus, the research areas are spreaded in variety of fields in social sciences, biology, chemisty, engineering, mathematics and physics. The current research activities of our group are nanophysics, granular physics, nonlinear rheology in glassy materials, biomechanics, and system biology. This academic year, Hayakawa, Saitoh and their coworkers have organized an international workshop "Recent Progress in Physics of Dissipative Particles -From fine powders to macroscopic behaviors of granular particles-".

Fluctuation theorem and generalized Green-Kubo formula for dissipative systems

Fluctuation theorem is one of key concepts for nonequilibrium statistical mechanics, which reproduces Green-Kubo formula in linearly nonequilibrium situations. So far the microscopic time reversal symmetry or the local detailed balance is believed to be necessary to hold such an identity, but Chong, Otsuki and Hayakawa found a counter example for this. Namely they derive the fluctuation theorem and an equivalent expression for the generalized Green-Kubo formula for granular systems in which both the time reversal symmetry and the local detailed balance do not hold. Hayakawa also apply this idea to characterize a quantum system.

Nonequilibrium dynamics for sheared dissipative liquids

Sheared dissipative liquids approach nonequilibrium steady states under the balance of viscous heating and dissipations. Similar to the previous topic, Chong, Otsuki and Hayakawa developed a generalized formalism to characterize a nonequilibrium steady state beyond the generalized Green-Kubo formula.

Jamming transition for sheared granular materials

Jamming transition is an athermal and a rigidity transition. Otsuki and Hayakawa intensively studied the rheological properties of frictionless granular particles near the jamming transition. They also developed the analysis for jamming transition for frictional grains.

Nonequilibrium dynamics of nano-particles:

Physics of nano-paryicles is strongly affected by thermal fluctuation and the boundary condition. Saitoh and Hayakawa studied the deformation of a graphene sheet after the impact of a nanocluster. Saitoh, Bodrova, Hayakawa and Brilliantov have found that there exists a negative restitution coefficient for an oblique collision between nanoclusters in the conventional definition. Then they proposed a proper definition of the restitution coefficient. This paper is selected as a paper of 'editors' suggestion" in Phys. Rev. Lett..

Towrads an understanding of living organisms:

Murase studied the living organisms based on their developmental and evolutionary perspectives. In the case of a living system, when we are confronting with seemingly incompatible results, we have to think that there must appear some hidden variables such as clonal variability (i.e., variable characteristics of clone cells), temporal variability such as time-dependent adaptation (i.e., learning or evolution of a living system under the environmental stimuli), mind-body relationships (i.e., the change of mind affects the state of body and vice versa) and so on. Biology of hypersensitivity was discussed from a point of view of interdisciplinary studies.

Universal scaling properities in circular DNA polymers:

Understanding statisitical properites of genomic DNA polymers is of fundamental importance in biological physics and quantitative molecular biology. Sakaue, Witz, Dietler and Wada studied both theoretically and experimentally the equilibrium properties of long circular DNA molecules deposited on the mica surface. They proposed a new interpolating formula for the bond orientational correlation function that encompasses the short- and large-distance behavior. Analytical findings including the proposed formula are in excellent agreement with the atomic force microscopy data without any fitting parameters.

Condensed-Matter Physics

The subjects of condensed-matter physics are the states of matter that emerge at low-temperatures as a consequence of non-trivial many-body effects. The main goal in this field is to understand how interplay among such low-energy degrees of freedom as charge, spin and (electron) orbital, when combined with a few simple fundamental principles (e.g. Fermi statistics, electromagnetic force), leads to a variety of phenomena. The area of current research in our group includes dynamical properties of strongly-correlated electron systems, physics of the iron-based- and the cuprate superconductors, and exotic phenomena in low-dimensional quantum magnetism.

Optical conductivity in one-dimensional Mott insulators: Sr_2CuO_3 is a Mott insulator described by one-dimensional Hubbard model. The optical conductivity above the Mott gap has been studied by using analytical and numerical methods. The Hubbard model, however, cannot explain midinfrared absorption inside the Mott gap, which is originated from phonon-assisted spin excitation. In order to understand both the Mott gap and spin excitations on the same footing, we need to treat the Hubbard model with optical phonons. Applying newly developed dynamical density matrix renormalization group techniques at zero and finite temperatures to a Hubbard-

Holstein model at half-filling, Sota and Tohyama examined the optical conductivity of a typical one-dimensional Mott insulator Sr_2CuO_3. They found a set of parameters in the Hubbard-Holstein model, which can describe optical conductivity for both Mott-gap excitation in the high-energy region and phonon-assisted spin excitation in the low-energy region. It was also found that electron-phonon interaction gives additional broadening in the temperature dependence of the Mott-gap excitation.

Pairing correlations near oxygen dopants in cuprate superconductors: Recent scanning tunneling microscopy/spectroscopy experiments on Bi-based cuprate superconductors have revealed an unexpected enhancement of the pairing correlations near the interstitial oxygen dopant ions. The origin of the enhancement is expected to be related to the pairing mechanism of high-temperature superconductivity. Tohyama and his collaborators proposed a possible mechanism based on local screening effects, by which the oxygen dopants do modify the electronic parameters within the CuO_2 planes and strongly increase the superexchange coupling. This enhances the spin pairing effects locally and explains the observed spatial variations of the density of states and the pairing gap as shown by exact-diagonalization calculations for the t-J model.

Magnetic quantum oscillations in cuprate superconductors: Recent quantum oscillation observations reported the presence of a small electron pocket in the underdoped cuprate high-temperature superconductors. From the observed oscillation period, it was found that the Fermi surface consists of small pockets. Tohyama and his collaborators showed that underdped $YBa_2Cu_3O_{6+y}$ has multiple holon pockets with different areas, which lead to multiple frequencies of magnetic quantum oscillations. Using neutron scattering data on incommensurate spin ordering, they determined these areas, which yields frequencies in good agreement with experiments. Divergence of the effective mass observed in magnetic quantum oscillations indicates a quantum phase transition at the oxygen content $y \approx 0.48$. It was argued that the transition is the onset of quasistatic incommensurate magnetic order predicted by theory and observed in neutron scattering.

Dirac fermions in antiferromagnetic metallic phase of iron-based superconductors: The iron-pnictide high-temperature superconductors have attracted much attention since their discovery. In the parent antiferromagnetic phase, the system remains metallic, contrary to the simple antiferromagnetic state in single band systems. Interestingly a Dirac fermion energy spectrum appears near the Fermi energy in this antiferromagnetic phase due to nontrivial topological properties. Morinari, Kaneshita, and Tohyama explored Dirac fermions in this system, and first pointed out that Dirac fermions contribute to the transport properties. They derived the effective theory describing the Dirac fermions based on the five-band model with the spin-density wave mean field analysis. Remarkably, it was found that two Dirac cones carry the same chirality contrary to other Dirac fermion systems, such as graphene. This result suggests that Dirac fermions can have a non-trivial topological characters in multi-band systems. Experimentally observed anomalous temperature dependence of the transport coefficients was explained by including the scattering rate difference between Dirac fermions and conventional electrons. In particular, sign changes in the thermopower and the Hall coefficient were consistently understood from the Dirac fermion picture. They also proposed that the Dirac fermion Landau level structure be observed by scanning tunneling spectroscopy measurements.

Interlayer magnetoresistance in multilayer Dirac fermion system: The organic conductor α-(BEDT-TTF)$_2$I$_3$ becomes a Dirac fermion system under high pressure on the order of 2GPa. The zero energy Landau level in Dirac fermions gives rise to a negative interlayer magnetoresistance that is observed experimentally. However, a positive interlayer magnetoresistance is observed for weak magnetic field. Morinari and Tohyama calculated the interlayer conductivity using the Kubo formula assuming a nonvertical interlayer tunneling and including higher Landau level effects. They showed that Landau level mixing effect upon non-vertical interlayer hopping lead to the experimentally observed crossover from the negative interlayer magnetoresistance to the positive interlayer magnetoresistance. In this crossover behavior the interlayer magnetoresistance shows a peak. They proposed a theoretical formula for the peak position. From the analysis of the experimental data they successfully determined the parameter for the Dirac fermion Landau level energy spectrum.

Inplane magnetoresistance in two-dimensional Dirac fermion system: An unusual inplane magnetoresistance was observed experimentally in the two-dimensional Dirac fermion systems. In particular, the in-plane magnetoresistance of α-(BEDT-TTF)$_2$I$_3$ exhibits a complicated temperature dependence. Under magnetic field, the in-plane resistivity decreases gradually as the temperature T is decreased for $T < 100$K. After reaching a broad minimum around 100K, the resistivity increases and then shows a narrow plateau region around several Kelvin. After that the resistivity increases again as the temperature is decreased further. Morinari and Tohyama presented the theory of the in-plane magnetoresistance in two-dimensional massless Dirac fermion systems including the Zeeman splitting and the electron-electron interaction effect on the Landau level broadening within a random phase approximation. They applied the theory to α-(BEDT-TTF)$_2$I$_3$, and obtained the result that is in good agreement with the experiment. The unusual behavior of the inplane magnetoresistance is basically understood as the result of the Dirac fermion Landau level structure.

Chirality in spin- 1/2 zigzag XY chain: A spin-1/2 zigzag XY chain is a typical one-dimensional quantum spin system with frustration caused by competition between the first and second nearest-neighbor exchange interactions. Recent studies have shown that a vector chiral long-range order occurs under certain conditions. The ground-state properties of the chain have extensively examined numerically and analytically, but the chiral properties at finite temperatures have not been studied so far. Sugimoto, Sota, and Tohyama studied spin chirality for the at low temperature by applying a low-temperature density-matrix renormalization group technique developed by Sota and Tohyama. They calculated temperature dependence of dynamical and static correlations of the chirality. In a chiral phase, chiral long-range order at zero temperature disappears at finite temperature, consistent with the fact that there is no long-range order at finite temperature in one-dimensional systems with short-range interactions. In a dimer phase next to the chiral phase, an enhancement of static chiral correlation as well as spin correlation was found with increasing temperature. The enhancement corresponds to the increase of spectral weight inside a gap in the dynamical chiral-correlation function. This temperature-induced chiral correlation is a demonstration of the presence of a chiral state in excited states.

Effects of Anisotropic Interactions in Two-Dimensional Shastry-Sutherland Model: The quasi-two-dimensional compound $SrCu_2(BO_3)_2$ has a unique crystal structure which leads to many interesting properties e.g. magnetization plateaus and an almost flat magnetic dispersion. Although the simplest theoretical model (Shastry-Suterland model) already captured several features of the compound, many things are yet to be fully understood. Among those open questions are the full phase diagram in magnetic fields and the behavior of the excitation spectra in magnetic phases (e.g. plateau phases). Romhányi, Totsuka and Penc developed a unifying formalism ('bond-wave method') to these problems based on the bond-operator mean-field theory. They obtained a reasonably good agreement between the theoretical results and the experimental observations.

Entanglement and Topological Order in Supersymmetric Valence-Bond-Solid Model: The valence-bond-solid (VBS) model is a paradigmatic model for the gapped spin-liquids in one dimension. Recently, this class of models attract renewed interest in view of the entanglement properties and symmetry-protected topological order. Hasebe and Totsuka investigated the entanglement properties of a generalization of this class of models which includes (fermionic) hole degrees of freedom as well as the bosonic spins. They found that symmetry connecting fermionic holes and bosonic spins (supersymmetry) stabilizes topological order in this system regardless of the values of the spin S. This is in contrast with what is known for the pure spin VBS models.

Various Valence-Bond Phases in Generalized Quantum Dimer Models: The quantum dimer model (QDM) is an interesting toy model which is tailored to deal with spin-singlet physics. It is known that QDMs exhibit various valence-bond phases as well as featureless spin liquids. However, in considering the connection with real magnets consisting of quantum spins, the standard QDM, which keeps only the lowest-order terms in the overlap expansion, may not be sufficient. Nakata and Totsuka generalized the model in such a way that the next leading order terms are included and investigated the valence-bond phases within perturbation expansion in the kinetic energy.

Nuclear Theory Group

The main focus of our research group is the basic investigation of nuclear physics covering all the physical phenomena governed by the strong interactions, such as the structure and the dynamics of nuclei and hadrons, and properties of hadron-quark many-body system in finite temperatures and densities. Here we briefly review our research activity in the academic year of 2010.

Nuclear structure and reaction

One of the goals of nuclear physics is to construct a unified comprehensive microscopic framework which can describe i) nuclear structure properties , ii) nuclear excitations (the variety of nuclear collective phenomena), and iii) nuclear reactions (fusion and fission). Recently, various new phenomena have been discovered in a region of unstable nuclei far from the stability line due to the progress of experimental facilities such as the RI beam factory. In theoretical studies of nuclear structure, it is desired to understand these phenomena of exotic nuclei and to provide theoretical predictions.

Unified understanding of the nuclear structure – cluster-shell competition: Itagaki and collaborators have proposed an effective model to describe the cluster-shell competition owing to the spin-orbit interaction and applied it to ^{20}Ne and ^{24}Mg. One of standard features of the nuclear structure is the shell structure; each proton and neutron (nucleon) performs independent motion in the mean potential created by the nucleons. Another important aspect of nuclear structure is the clustering phenomenon. Here, strongly correlated nucleons construct subsystems called clusters, which are spatially localized. The most famous example is α cluster consisting of two protons and two neutrons. If an α cluster is expressed as the simplest configuration, it is a spin-zero system where only the central interactions contribute, and the spin-orbit interaction, which is important for the independent motion of the protons and neutrons in the shell model, does not work. Therefore, the stability of such a cluster and its physical significance are closely related to the respective role of different components of the nuclear interaction. In the present model, by introducing only two parameters, a continuous transformation of an α cluster (two α clusters) into four (eight) independent nucleons around the Oxygen nucleus in ^{20}Ne (^{24}Mg) can be described, and these parameters are a measure of the cluster-shell competition. A possible connection to the group theoretical understanding of the cluster-shell transition was also discussed.

Gas-like states of α clusters: Itagaki and collaborators have discussed gas-like state of α clusters in a medium heavy nucleus. It has been studied for a long time that some of the excited states of light nuclei can be interpreted in terms of gas-like structure of α clusters. One of the most well known examples is the second excited state of ^{12}C nucleus, which has a structure of three α clusters and plays an essential role for the synthesis of Carbon in starts. Here, three α weakly interact with each other and have dilute distribution. We have discussed that such gas like state of α clusters exist not only in light nuclei but in heavier nuclei in more general. Three α clusters have dilute distribution around ^{40}Ca, which is consistent with a recent experimental indication. In addition, Ichikawa, Itagaki, and collaborators have studied gas-like states of α clusters around an ^{16}O core in ^{24}Mg based on a microscopic α-cluster model. The 0^+ states below the ^{16}O+α+α threshold, which are candidates for the resonance solution judging from the energy convergence behavior, are strongly excited by an isoscalar monopole (E0) operator from the ground state, which could be observed as an experimental signature of well developed α gas-like states in the excited states. These states have significant overlaps with the THSR (Tohsaki Horiuchi Schuck Röpke) wave functions with large spatial extension. Furthermore, Itagaki and collaborators have discussed the relation between the monopole transition strength and existence of cluster structure in the excited states based on an algebraic cluster model. The structure of ^{12}C has been studied with a 3α model, and the wave function for the relative motions between α clusters have been described by the symplectic algebra $Sp(2,R)_z$, which corresponds to the linear combinations of SU(3) states with different multiplicities. Introducing $Sp(2,R)_z$ algebra works well for reducing the number of the basis states, and it is also shown that states connected by the strong monopole transition are classified by a quantum number Λ of the $Sp(2,R)_z$ algebra.

Nuclear fission reaction: Ichikawa and collaborators investigated the nuclear fission reaction for ^{180}Hg. For lighter-mass systems, it has often been assumed that fission mass distributions are symmetric. However, a recent experiment showed that fission of ^{180}Hg following electron capture on ^{180}Tl is asymmetric. To investigate the origin of the mass-asymmetric fission in ^{180}Hg, they calculated the five-dimensional potential energy surfaces with respect to the nuclear deformation parameter and analyzed the energy optimum path from the ground state to the scission point. They discussed the difference in the mass-asymmetric fission paths between the mercury and actinide nuclei.

Nuclear scattering reaction: Furumoto and his collaborators investigated the property of optical potential in the high-energy heavy-ion scattering. They predicted the repulsive potential with microscopic procedure in the energy evolution. The potential gives the characteristic diffraction pattern of the elastic-scattering angular distribution. This is clearly explained in terms of the nearside and farside decomposition of the scattering amplitude. Its measurement will provide a clear evidence of the attractive to repulsive transition of the heavy-ion potential. Furumoto and his collaborators studied the nuclear reaction dynamics for the elastic scattering of ^{8}B from ^{12}C. The ^{8}B nucleus consists of weakly bound ^{7}Be and proton, while the ^{7}Be nucleus has an internal cluster structure of α + ^{3}He. They treated the last proton in ^{8}B in the adiabatic recoil approximation and also took into account the excited and resonance states of ^{7}Be by a coupled-channel method. It was found that the effect of the inner cluster excitation (^{7}Be*) in ^{8}B is important for the ^{8}B elastic scattering.

Hadron structure and dynamics

Helicity amplitudes of the $\Lambda(1670)$ *and two* $\Lambda(1405)$ *as dynamically generated resonances:* Jido and his collaborators calculated the helicity amplitudes $A_{1/2}$ and radiative decay widths in the transition $\Lambda(1670) \to \gamma Y$ ($Y = \Lambda$ or Σ_0). The $\Lambda(1670)$ is treated as a dynamically generated resonance in meson- baryon chiral dynamics. They obtained the radiative decay widths of the $\Lambda(1670)$ to $\gamma\Lambda$ as 2 ± 1 keV and to $\gamma\Sigma_0$ as 120 ± 50 keV. Also, the Q^2-dependence of the helicity amplitudes $A_{1/2}$ was calculated. They found that the $K\Xi$ component in the $\Lambda(1670)$ structure, mainly responsible for the dynamical generation of this resonance, is also responsible for the significant suppression of the decay ratio $\Gamma_{\gamma\Lambda}/\Gamma_{\gamma\Sigma_0}$. A measurement of the ratio would, thus, provide direct access to the nature of the $\Lambda(1670)$. To compare the result for the $\Lambda(1670)$, they calculated the helicity amplitudes $A_{1/2}$ for the two states of the $\Lambda(1405)$.

Internal structure of the resonant $\Lambda(1405)$ *state in chiral dynamics:* Sekihara, Jido and their collaborator studied the internal structure of the resonant $\Lambda(1405)$ state based on meson-baryon coupled-channel chiral dynamics by evaluating density distributions obtained from the form factors of the $\Lambda(1405)$ state. The form factors are defined as an extension of the ordinary stable particles and are directly evaluated from the current-coupled meson-baryon scattering amplitude, paying attention to the charge conservation of the probe interactions. For the resonant $\Lambda(1405)$ state they calculated the density distributions in two ways. One is on the pole position of the $\Lambda(1405)$ in the complex energy plane, which evaluates the resonant $\Lambda(1405)$ structure without contamination from nonresonant backgrounds, and another is on the real energy axis around the $\Lambda(1405)$ resonance energy, which may be achieved in experiments. Using several probe interactions and channel decomposition, they found that the resonant $\Lambda(1405)$ state is composed of widely spread $\bar{K}$ around N, which gives dominant component inside the $\Lambda(1405)$, with escaping $\pi\Sigma$ component.

Nature of the σ *meson as revealed by its softening process:* Jido and his collaborators studied the $\pi\pi$ scattering in two-flavor chiral models with a finite pion mass to investigate the nature of the σ meson. They compared several models with different origins of the σ meson, such as the chiral partner of π and the dynamically generated $\pi\pi$ molecule. They found that the dynamically generated σ meson exhibits a novel pattern of the threshold enhancement reflecting the *s*-wave nature of the resonance, which is qualitatively different from the softening of the chiral partner introduced as a bare field. This behavior around the threshold energy region is universal as far as the bare σ pole stays away from the threshold throughout the symmetry restoration process. In contrast, for $m_\pi = 0$, the dynamically generated σ behaves similarly to the chiral partner in the symmetry restoration limit, implying the possibility of the dynamically generated chiral partner.

$K\Lambda(1405)$ *configuration of the* $K\bar{K}N$ *system:* Martínez Torres and Jido studied the $K\Lambda(1405)$ configuration of the $K\bar{K}N$ system by considering $K\pi\Sigma$ as a coupled channel. They solved the Faddeev equations for these systems and found confirmation of the existence of a new N^* resonance around 1920 MeV, with $J^\pi = 1/2^+$ predicted in a single-channel potential model and also found in a Faddeev calculation as an $a_0(980)N$ state, with the $a_0(980)$ generated in the $K\bar{K}$, $\pi\eta$ interaction.

Theoretical study of incoherent ϕ *photoproduction on a deuteron target:* Sekihara, Martínez Torres, Jido and their collaborator studied the photoproduction of ϕ mesons in deuteron, paying attention to the modification of the cross section from bound protons to the free ones. Taking into account Fermi motion in single scattering and rescattering of ϕ to account for ϕ absorption on a second nucleon as well as the rescattering of the proton on the neutron, they find that the contribution of the double scattering for ϕ is much smaller than the typical cross section of $\gamma p \to \phi p$ in free space. The contribution from the proton rescattering, on the other hand, was found to be not negligible and leads to a moderate reduction of the ϕ photoproduction cross section on a deuteron at forward angles. The Fermi motion allows contribution of the single scattering in regions forbidden by phase space in the free case. For momentum transferred squared close to the maximum, the Fermi motion changes drastically the shape of $d\sigma/dt$, to the point that the ratio of this cross section to the free one becomes very sensitive to the precise value of t chosen.

Diquarks in a QCD sum rule perspective: Jido, Su Houng Lee, who is one of visiting professors of YITP, and their collaborator proposed a phenomenological QCD sum rule with explicit diquark fields to investigate the essential ingredients inside the hadrons. By introducing the mass m_ϕ and the condensate $\langle\phi^2\rangle$ for the diquark field as parameters in the model, they found that the sum rule works well for Λ, Λ_c and Λ_b. This implies that these Λ baryons can be represented by a diquark and a quark configuration. They also found that there is a duality relation among the parameters $(m_\phi, \langle\phi^2\rangle)$ for which the sum rule is equally good, and obtained $m_\phi = 400$ MeV in the limit $\langle\phi^2\rangle = 0$, which can be thought of as the constituent diquark mass.

Λ *hypernuclei and neutron star matter in a chiral SU(3) relativistic mean field model with a logarithmic potential:* Ohnishi in collaobration with Tsubakihara, Maekawa and Matsumiya developed a chiral SU(3) symmetric relativistic mean field model with a logarithmic potential of scalar condensates. Experimental and empirical data of symmetric nuclear matter saturation properties, bulk properties of normal nuclei, and separation energies of single- and double-Λ hypernuclei are well explained. The nuclear matter equation of state (EOS) is found to be softened by $\sigma\zeta$ mixing which comes from determinant interaction. The neutron star matter EOS is further softened by hyperons, and would not be compatible with the 2 $M_\odot$ neutron star discovered after completing this work.

QCD matter and phase diagram

QCD phase diagram from the thermal statistical model: Fukushima investigated the QCD phase diagram by matching the entropy density estimated from the thermal statistical model and the quark-based effective model. He found that the effective model cannot be consistent with the statistical model without inclusion of back-reaction from the matter sector to the gluonic sector. His conclusion is that common results from the effective model leading to chiral restoration in the confined phase is an artifact due to the lack of back-reaction.

Chiral and deconfinement transitions in strong coupling lattice QCD with finite coupling and Polyakov loop effects: Nakano and Ohnishi in collaboration with Miura and Kawamoto investigated chiral and deconfinement transitions in the strong coupling lattice QCD at finite temperature and quark chemical potential. They took account of the leading order Polyakov loop terms as well as the next-to-next-to-leading order fermionic terms of the strong coupling expansion. The Polyakov loop is found to suppress the chiral condensate and to reduce the chiral transition temperature at zero quark chemical potential. As a result, the chiral transition temperature roughly reproduces the Monte Carlo results at medium coupling.

Chaotic behavior in classical Yang-Mills dynamics: Understanding the underlying mechanisms causing rapid thermalization deduced for high-energy heavy ion collisions is still a challenge. To estimate the thermalization time, Ohnishi in collaboration with Kunihiro, Müller, Schäfer, Takahashi and Yamamoto studied entropy growth for classical Yang-Mills theories based on the determination of Lyapunov exponents. Distinct regimes for short, medium and long sampling times are characterized by different properties of their spectrum of Lyapunov exponents. Clarifying the existence of these regimes and their implications for gauge-field dynamics is one of the results of this contribution. As a phenomenological application it is concluded that for pure gauge theories with random initial conditions thermalization occurs within few fm/c, an estimate which can be reduced by the inclusion of fermions, specific initial conditions, etc.

Entropy current for the relativistic Kadanoff-Baym equation and H-theorem in $O(N)$ theory with NLO self-energy of $1/N$ expansion: Nishiyama and Ohnishi derived an expression of the kinetic entropy current in the nonequilibrium $O(N)$ scalar theory from the Schwinger-Dyson (Kadanoff-Baym) equation with the 1st order gradient expansion. It is shown that the derived kinetic entropy satisfies the H-theorem for the leading order of the gradient expansion with the next-to-leading order self-energy of the $1/N$ expansion in the symmetric phase, and that entropy production occurs as the Green's function evolves with an nonzero collision term. Entropy production stops at local thermal equilibrium where the collision term contribution vanishes and the maximal entropy state is realized. They also compare the entropy density with that in thermal equilibrium which is given from thermodynamic potential or equivalently 2 particle irreducible effective action.

QCD in a strong magnetic field: Marco Ruggieri, in collaboration with Raoul Gatto, has evaluated the dressed Polyakov loop for hot quark matter in strong magnetic field. To compute the finite temperature effective potential, he has used the Polyakov extended Nambu–Jona Lasinio model with eight-quark interactions taken into account. The parameters of the model have been set to reproduce the physical decay constant and mass for the pion in the vacuum, namely $f_\pi = 92.3$ MeV and $m_\pi = 139$ MeV. His results show that the dressed Polyakov loop is very sensitive to the strength of the magnetic field, and it is capable to capture both the deconfinement crossover and the chiral crossover. Additionally, he has self-consistently computed the phase diagram hot quark matter in a strong magnetic field. He has found that deconfinement and chiral symmetry restoration temperatures are *enhanced* by a strong magnetic field, in agreement with the results obtained independently by other groups; besides, he also found a tiny split of the two aforementioned crossovers, as the strength of the magnetic field is increased. Concretely, for the largest value of magnetic field investigated, $eB = 19m_\pi^2$ ($eB = m_\pi^2 \to B \approx 2.2 \times 10^{14}$ Tesla), the split is of the order of 10%, opening thus the possibility of a constituent quark phase at large temperature.

Non-topological solitons: Marco Ruggieri, in collaboration with Leonardo Campanelli, has studied non-topological, charged planar walls (Q-walls) in the context of a particle physics model with supersymmetry broken by low-energy gauge mediation. He has derived analytical properties within the so-called flat-potential approximation for the flat-direction raising potential; besides, he has performed a numerical study with the two-loop supersymmetric potential. He has analyzed the energetics of finite-size Q-walls, and compared them to Q-balls, non-topological solitons possessing spherical symmetry and arising in the same supersymmetric model.

Inhomogeneous chiral symmetry breaking phase on QCD phase diagram: Kamikado investigated the possibility of the inhomogeneous chiral symmetry broken phase in the QCD phase diagram in temperature and baryon chemical potential plane. In the simplest inhomogeneous condensation form referred to as the dual chiral density wave (DCDW), he investigated the influence of isospin chemical potential. At zero isospin chemical potential, DCDW phase appears below the critical end point; the first order phase transition boundary is replaced by the region surrounded by two second order phase transition boundaries. The critical end point is found to move in the lower temperature direction and the DCDW phase becomes narrower with increasing isospin chemical potential. The critical end point and DCDW phase disappear for sufficiently large isospin chemical potential values.

Particle Physics Group

Particle physics is a branch of physics studying the origin of matter and space-time as well as their interactions, the most fundamental problems in Nature. Its final goal is to reveal the underlying physical laws and components of the nature. A lot of important mysteries are remaining unanswered, and this group has research activities in various directions to reach this goal.

In particle phenomenology, the current experimental results are considered to be very accurately described by the Standard Model (SM) with $SU(3) \times SU(2) \times U(1)$ gauge group. However, this model cannot be a complete theory for the following reasons; it contains too many tunable parameters which can only be determined by experiments, it suffers from the hierarchy problem, and it does not contain the dark matter and the neutrino masses. Thus particle physics beyond the SM is actively investigated by many members of this group. The study of the Higgs sector is now one of the hot topics thanks to the LHC experiments at CERN. The Higgs sector explains the origin of the particle masses through the mechanism of the spontaneous symmetry breaking. Another important topic is the mechanism of the supersymmetry breaking. The supersymmetry is a highly attractive idea, since it solves the hierarchy problem of the SM and unifies naturally the gauge couplings of the SM at a high energy scale, suggesting a Grand Unified Theory (GUT) of gauge fields and matters. However, no experimental evidence of the supersymmetry has been observed yet. Reconciliation of the present experimental situation with theoretical requirements is highly wanted. Supergravity, that is a local gauge theory of supersymmetry, is also investigated by some members of the group.

Quantum Chromodynamics (QCD) is a non-Abelian gauge theory coupled with matter fields. This theory describes the hadronic systems, and has various applications in particle phenomenology as well as in astrophysics. Because of its strong interactions, understanding its properties requires non-perturbative approaches to quantum field theories. Lattice QCD gives a practical and powerful numerical method to analyze the non-perturbative aspects of QCD. Recently, a new method based on the duality between gravity and gauge theory has emerged from the study of string theory. This new method analyzes QCD in terms of gravity or string theory, and can relatively easily derive some results which are difficult to obtain directly from gauge theory per se.

It is yet not known how to incorporate the principle of quantum mechanics into the gravity or the general relativity. Application of the standard quantization procedure to the general relativity is met with many serious problems, including uncontrollable UV divergence. A consistent theory of quantum gravity seems to require a new notion of space-time, which replaces the classical space-time notion that is a continuous smooth manifold. Noncommutative space-time (or fuzzy space, more generally) is one candidate, which actually has been noted to appear in quantum gravity and string theory under certain conditions. Based on this quantum space-time notion, quantum gravity is investigated by some of the group members.

String theory is a theory of one-dimensionally extended objects like string, trying to give a consistent unified theory of all the interactions and matters. To relate the string theory to the real nature, compactification is a necessary step, since the consistency of the string theory requires the space-time dimension to be ten, and the extra six-dimensions must be compactified to small sizes. The mode of compactification determines the possible contents of gauge theory and matters in low energy, and finding realistic compactifications is an important topic. This is studied by the group members. However, at present infinite possibilities of compactifications are known, and non-perturbative formulation of the string theory seems to be required for it to have predictable powers to the real nature. As study in this direction, the string field theory and the M-theory are investigated by the group members, too. Black hole physics based on string theory and mathematical aspects of string theory are also actively researched by the group members.

Historically the development of particle physics came hand in hand with that of field theory, which is not only a common language of particle physics but also a central tool in modern theoretical physics, including cosmology, condensed matter, and statistical physics. Thinking of this powerful generality of field theory, some of the group members study related topics in condensed matter physics and integrable systems.

Here is a summary of main works of the members of particle physics group in the academic year 2010.

Particle phenomenology and supersymmetry

— nonlinearly realized extended supersymmetry —
Izawa, *Nakai*, and *Shimomura* provided a nonlinear realization of supergravity with an arbitrary number of supersymmetries based on coset construction. The number of gravitino degrees of freedom counts the number of supersymmetries, which will be possibly probed in future experiments. Goldstino embedding in the construction was considered to discuss the relation to nonlinear realization with rigid supersymmetries.

— gravitational supersymmetry breaking —
Izawa and *Kugo* with Yanagida considered supersymmetry breaking models with a purely constant superpotential. Then the supersymmetry breaking is induced for the vanishing cosmological constant. As a hidden mediation sector of supersymmetry breaking, it naturally leads to a split spectrum in supersymmetric standard model. Possible utility of this setup was also pointed out to construct nonlinear sigma model and/or Fayet-Iliopoulos-like term in broken supergravity.

— quasi-Nambu-Goldstone fermions —

Some time before *Kugo* with Yanagida proposed an idea that the three families of quarks and leptons may be understood as superpartner fermions of the Nambu-Goldstone bosons, associated with a spontaneous breaking of a certain bosonic global symmetry in a supersymmetric theory. If the yet unknown fundamental theory possesses a global E_7 symmetry as well as supersymmetry, and if the E_7 is spontaneously broken to $SU(5)$ times some $U(1)$'s, then three generations of $\mathbf{5}^* + \mathbf{10}$ representations of $SU(5)$ appear as massless NG supermultiplets aside from one $\mathbf{5}$ supermultiplet which may be identified as the Higgs multiplet. Reviving their old ideas on quasi-N-G fermions, *Kugo* and Yanagida investigated deformations of supersymmetric non-linear sigma models for the coset G/H. They showed that the Kähler potential can be made exactly G-invariant if and only if one enlarges the manifolds by dropping all the $U(1)$'s in the unbroken subgroup H. This allowed those nonlinear sigma models to be coupled to supergravity without losing the G invariance.

— *dark matters* —
Takayama investigated dark matter physics in various contexts. They are concerned with dark matter models in which long-lived massive particles play important roles in the history of the Universe; dark matter indirect searches and dark matter collider searches.

— *neutrinos and flavour structure* —
Neutrino physics can be a good clue to learn the flavour structure of particle models. *Takayama* with *Azuma* investigated the roles of possible discrete symmetries which may govern the observed flavour structures of particle models and they gave further predictions in neutrino mass matrices like θ_{13}.

QCD and lattice QCD

— *lattice fermions* —
Misumi and collaborators developed a novel type of lattice fermions with exact locality and chiral symmetry, which belong to the "minimally doubled fermions." These lattice fermions enabled direct simulation of the two-flavor QCD if the rotational symmetry breaking was properly taken care of. He also investigated the generalization of the Wilson fermion, which also gave a wide class of the overlap and domain-wall fermions. With these lattice fermions, they derived a lattice gauge theory version of an index theorem which counted the gauge topology. He with Creutz and Kimura constructed the staggered-Wilson and staggered-overlap fermions for more efficient and speedy simulations of lattice QCD.

Quantum gravity

One of the main purposes of quantum gravity is to construct a theory which does not contain space-time in its basic formulation but generates it as an emergent infrared phenomenon. Among various proposals of such theories, the tensor model is recently being actively studied by not a few young researchers. Encouraged by the success of the matrix model as the two-dimensional simplicial quantum gravity, the tensor model was proposed a long time ago by *Sasakura* and some others to give a well-defined model of the simplicial quantum gravity with arbitrary dimensions.

—*new approach to tensor model* —
Sasakura's new approach was specifically considering the rank-three tensor models as a theory of dynamical fuzzy spaces. The main advantage was that the rank-three tensor model can treat any dimensional cases, while the rank of the tensor model depended necessarily on dimensions if the tensor model was interpreted as describing the simplicial quantum gravity. This led to the expectation that the rank-three tensor model would give a unified formulation which generates various dimensional space-times. Coarse graining procedures for the rank-three tensor models adopted by *Sasakura* showed that certain configurations with Gaussian functions were the attractors of the coarse graining procedures. This led to the conclusion that if a space is generated, the infrared dynamics of perturbations should be described by a scalar-tensor theory of gravity.

String theory & SUSY gauge theories

— *AGT conjecture* —
Hosomichi and collaborators investigated the worldvolume theory on S-duality domain walls in 4D $\mathcal{N} = 2^*$ SYM theory. They computed its partition function on S^3 using the formulae developed originally by Kapustin et. al. and generalized to arbitrary $\mathcal{N} = 2$ SUSY gauge theories by themselves. The partition function was shown to agree precisely with the modular transformation coefficients of torus 1-point conformal blocks, as expected from the AGT conjecture. *Maruyoshi* and *Taki* investigated the the AGT relation between 4D gauge theory and 2D CFT. They showed that the effective theories of $N = 2$ gauge theories are described by certain integrable systems associated with the Seiberg-Witten theory. *Taki* analyzed the surface operator appearing in the above realization and pointed out that they came from D-branes of string theory via stringy realization of gauge theories.

— *partition functions for squashed spheres* —
Hosomichi, *Hama* and a collaborator extended the formulae for 3D partition functions to a few examples of squashed spheres. For ellipsoids with certain background $U(1)$ R-symmetry gauge field turned on, they found an interesting one-parameter generalization of Kapustin's formula.

— *black holes*—
Terashima, *Ogawa* and a collaborator investigated the zero entropy limit of the near horizon geometries of $D = 4$ and $D = 5$ extremal black holes. Certain conditions on the geometries were derived from mild regularity requirements on the geometries. An AdS_3 structure was shown to emerge in a certain scaling limit, though the period shrank to zero. The results had some implications to the Kerr/CFT correspondence.

— *M5 branes* —
Terashima and *Yagi* constructed an effective action of multiple M5-branes using the ABJM action, which would be highly important to unify dualities of suspersymmetric field theories. A D4-brane-like action was obtained which had a space-time coordinates dependent gauge coupling strength. This was consistent with the expected proper-

ties of M5-brane action. For the full understanding of M5-branes, it became apparent that monopole operators must be taken into account. The Nambu-Poisson bracket was hidden in the solution.

— *$su(2|2)$ light-cone string field theory* —
Kishimoto and *Moriyama* investigated the $su(2|2)$ light-cone string field theory. By revisiting the pp-wave light-cone string field theory, they found that most of the results can be obtained without taking the exact limit. Namely, in the pp-wave limit, the renormalized momentum at the interaction point was solved in terms of the string oscillators and it satisfied some crucial algebraic relations for constructing the light-cone string field theory. Without the explicit oscillator expression on the $su(2|2)$ background, they found similar algebraic relations from consistency conditions by assuming the existence of the renormalized momentum and they proposed an algebraic model for the light-cone string field theory on this background.

— *superstring field theory* —
Kohriki, *Kunitomo* and *Murata* proved the no-ghost theorem for Neveu-Schwarz string directly in 0-picture used in the modified cubic superstring field theory. The one-to-one correspondence between physical states in 0-picture and in the conventional (-1)-picture was confirmed. It was shown that a non-trivial metric consistent with the BRST cohomology is needed to define a positive semidefinite norm in the physical Hilbert space. As a by-product, they found a new inverse picture-changing operator, which was non-covariant but had a nonsingular operator product with itself. A possibility to construct a new gauge-invariant superstring field theory was discussed.

— *elliptic genera* —
Eguchi examined the elliptic genus of K3 surface, expanded it into irreducible characters of $N = 4$ superconformal algebra (SCA) together with Ooguri and Tachikawa. He found that the multiplicities of non-BPS representations $A(n)$ $(n = 1, 2, 3, \dots)$ at lower values of n are given by a sum of dimensions of irreducible representations of the sporadic discrete group Mathieu24 (M24). This phenomenon is similar to the famous monstrous moonshine where the Fourier coefficients of elliptic J-function are given by the sum of representations of monster group. By replacing the identity element by elements of M24 one can introduce analogues of McKay-Thompson series called as twisted elliptic genera. There exists one twisted genus corresponding to each conjugacy class of M24. Together with Hikami, *Eguchi* completed the construction of 26 twisted genera of K3 and showed that $A(n)$ can be decomposed into a sum of dimensions of representations R_i of M24 as $A(n) = \sum_{i=1}^{26} a_i(n) \dim(R_i)$ with $a_i(n)$ all positive integers up to $n = 1000$. Thus Mathieu moonshine conjecture has very strong empirical evidence. It is well-known that M24 has an intimate relation with the Golay code and Leech lattice. Since $A(n)$ has an exponential behavior at large n and related to an entropy of a small black hole, Mathieu moonshine may have interesting implications on the symmetry of black hole microstates.

Condensed matter physics

— *gauge theory and graphene* —
Great attention has recently been directed to graphene, an atomic layer of graphite, which supports "Dirac fermions" as charge carriers and which thus is of interest to particle physicists as well. Graphene, unlike conventional quantum Hall systems, leads to a variety of cyclotron resonances, both intra- and inter-band ones, and offers the challenge of detecting many-body corrections to cyclotron resonance. *Shizuya* had earlier studied Coulombic many-body corrections to cyclotron resonance in graphene and its bilayers, pointed out the need for renormalization and examined its consequences. This year he refined his analysis of cyclotron resonance in bilayer graphene with a weak electron-hole asymmetry, intrinsic to bilayers and known from experiment, taken into account, and discussed its consequences in comparison with some recent experiments.

Integrable systems

— *quantum groups & algebras* —
Rich algebraic structures emerge out of integrable models, which have played a key role in condensed matter systems as well as gauge and string theories. *Young* and collaborators investigated finite-dimensional representations of quantum affine algebras. They established a link between "singlets" in tensor products of fundamental representations, and a "fusing rule" originating in affine Toda field theories. *Young* and a collaborator applied the "nested Bethe ansatz" to solve certain particle scatterings between two boundaries, which arose in the computation of the operator spectrum of $N = 4$ super-Yang Mills theory.

— *discrete quantum mechanics* —
Many important examples were worked out in 'discrete' quantum mechanics, which was proposed by *Sasaki* and Odake. Its Schrödinger equation is a difference instead of a differential equation. With *García-Gutiérrez*, the Crum-Adler theorem in quantum mechanics was generalised to discrete quantum mechanics with the pure imaginary shifts. The real shifts case was formulated as dual Christoffel transformations. Derivation of the exceptional Askey-Wilson type polynomials through Darboux-Crum transformation was achieved. These were also summarised in two review articles of 'discrete' quantum mechanics.

— *exceptional orthogonal polynomials* —
The theory of the exceptional orthogonal polynomials, discovered by *Sasaki* and Odake, was further developed. The exceptional Laguerre and Jacobi polynomials were rederived in terms of Darboux-Crum transformation with Tsujimoto and Zhedanov. The continuous ℓ version of the exceptional Laguerre and Jacobi polynomials was constructed with Odake.

Yukawa International Program for Quark-Hadron Sciences

From the beginning of the academic year of 2007, Yukawa Institute for Theoretical Physics launched a new five-year project, "Yukawa International Program for Quark-Hadron Sciences (YIPQS)", sponsored by "Ministry of Education, Culture, Sports, Science and Technology, JAPAN (MEXT)". At the end of the academic year of 2010, the government approved to convert the YIPQS project budget into a more stable normal budget, and now we can run the program from a longer term point of view.

Aim of the program

By the end of 1970's, the final understanding was reached that Quantum Chromodynamics (QCD) is the fundamental theory of the strong interaction which was originally discovered by Hideki Yukawa. Still, nevertheless, only little has been established from QCD on various possible forms of hadrons or quarks. For example, while scaling behaviors of the lepton-nucleon cross section in the deep-inelastic scattering region and some properties of ground state hadrons have been precisely understood in perturbative and lattice QCD calculations, respectively, the study of bare nuclear force just started very recently. We have not yet reached the stage to understand properties of excited hadrons above the threshold including the exotic hadrons, binding mechanism of nuclei with more than two nucleons, nuclear matter equation of state, and the vacuum structures at extremely high temperature in the Early Universe and at extremely high density in compact stars, from the fundamentaly theory, namely QCD. In other words, there is still a vast area of research interest which is to be explored. To advance our exploration, it is necessary not only to make full use of existing theoretical techniques but also to develop new theories and to establish new frameworks. The expected achievement would cast a strong impact on our understanding of various forms of matter at various levels in nature. One may face a situation that one should restructure the current understanding about possible forms of matter.

The primary purpose of the YIPQS is to establish a new area of research fields; the quark-hadron sciences. For this purpose, with cooperating with present and near-future experimental activities, Yukawa Institute for Theoretical Physics will advance theoretical research not only in quark-hadron physics but also in related areas, as listed below, which constitute indispensable building blocks for the quark-hadron sciences.

Examples of related areas include; quark-gluon plasma, hadron physics, lattice QCD, dark energy, dark matter, baryogenesis, CP violation, strongly-correlated systems, phase transition of internal degrees of freedom of matter, physics of the Early Universe, matter at extreme conditions, structure of unstable nuclei and nucleosynthesis, compact star physics, optical lattice, (super)string theory, AdS/CFT correspondence, non-perturbative and/or non-equilibrium dynamics, etc.

International collaboration program

As a core activity of the YIPQS, long-stay programs are organized on research topics ranging over quark-hadron physics and related fields of theoretical physics. The proposal of the program is open for the community, with a requirement that the organizing committee should include a member of Yukawa Institute. The theme of the long-stay program is selected by the YIPQS executive committee with taking account of comments and opinions from the international advisory committee. The program is to be endorsed by the steering/advisory committee of the Yukawa Institute. The proposed program plan is also to be examined by the user's committee of the Yukawa Institute.

Two to three long-stay programs will be held annually; the duration of each program is one to three months. World-leading scientists are invited for each theme, and the Yukawa Institute provides participants with relaxed and at-home atmosphere so that there may be active discussions and fruitful collaborations, which we hope that will ultimately lead to Nobel-prize class results. To publicize the aim of creating and advancing the field of quark-hadron sciences, the activities and outcomes of the YIPQS will be announced regularly on the website.

In this academic year the following **two** long-stay programs were held;

1. May 24 – Jul. 16, 2010: "Gravity and Cosmology 2010"
   http://www2.yukawa.kyoto-u.ac.jp/˜ykis2010/
   Chairman: Misao Sasaki

2. Jul. 26 – Aug. 27, 2010: "High Energy Strong Interactions - Parton Distributions and Dense QCD Matter -"
   http://www2.yukawa.kyoto-u.ac.jp/˜hesi10
   Chairman: Kenji Fukushima

The detailed information of each program can be seen at the website written above.

Smaller-size international collaboration programs are also organized to cope with the rapid development of the research in this field. The program is named a "molecule-type" international program. It is expected that the group discussion in this small program will evolve to form a research collaboration. The proposal has been received anytime within the budget limit. This program should involve at least one core participant from abroad, and should be long for two weeks or more. The selection of this program is also made by the executive committee.

In this academic year there were **three** international programs of this molecule-type as listed below;

1. May 17 – 30, 2010: "Exotics from heavy ion collisions"
   Core members: Che-Ming Ko, Su Houng Lee, Akira Ohnishi

2. Mar. 1 – 21, 2011: "Nuclear structure/reaction and surface of neutron star studied with time-dependent Hartree-Fock theory"
   Core members: Joachim A. Maruhn, Naoyuki Itagaki

3. Mar. 13 – 26, 2011: "Cosmological perturbation and CMB"
   Core members: Robert Crittenden, Alexei Starobinsky, Kazuhiro Yamamoto, Misao Sasaki,Takahiro Tanaka

Organization

The executive committee was organized in the Yukawa Institute to run the whole program. The committee members are;
Akira Ohnishi (chair), Taichiro Kugo (vice-chair), Tohru Eguchi, Kenichi Shizuya, Misao Sasaki, Takami Tohyama, Hisao Hayakawa, Takahiro Tanaka, Kenji Fukushima, Hiroshi Kunitomo, Naoyuki Itagaki, Teiji Kunihiro, Koichi Yazaki.

One special duty professor, one associate professor and three postdocs were hired to enhance the research activities at the Yukawa Institute.

The website of the program is;
http://www2.yukawa.kyoto-u.ac.jp/˜yipqs/index-e.html.

2.2 Research Highlights

Negative Normal Restitution Coefficient Found in Simulation of Nanocluster Collisions

Kuniyasu Saitoh (YITP), Anna Bodrova, Hisao Hayakawa (YITP) and Nikolai V. Brilliantov

Inelastic collisions is the process that part of the mechanical energy of colliding bodies transforms into heat. They commonly appear in nature and industry. In particular, they play the essential role in physics of granular materials. Such collisions is characterized by the normal restitution coefficient e. According to a standard definition, it is equal to the ratio of the normal component of the rebound speed, $\mathbf{g}'$ where the prime states for the post-collision value, to the impact speed, $\mathbf{g}$

$$e = \frac{\mathbf{g}' \cdot \mathbf{n}}{\mathbf{g} \cdot \mathbf{n}}. \tag{1}$$

The unit intercenter vector $\mathbf{n}$ at the collision instant specifies the impact geometry. From a classical experiment by Newton, e is believed to be a material constant. Since particles bounce in the direction opposite to that of the impact, e is positive, $e > 0$, and since the energy is lost in collisions, e is smaller than 1, that is, $0 \leq e \leq 1$. This is a common statement in the majority of mechanical textbooks.

Recent experimental and theoretical studies show, however, that the concept of a restitution coefficient is more complicated. First, e depends on an impact speed and second[1]. Second, it can exceed unity for a special case of oblique collisions with an elastoplastic plate[2]. Third, the bouncing nanoclusters demonstrate that the normal restitution coefficient can exceed unity even for strictly head-on collisions.[3]

In this study, Saitoh *et al.* investigated the oblique impact of nanoclusters with the reduced adhesion by means of molecular dynamics and theoretically, using concepts of continuum mechanics. They have found that the normal restitution coefficient, as defined by Eq. (1), can become negative values $e < 0$ even after they performed the ensemble average. They explained this effect by the reorientation of the contact plane during an impact and quantify it. Moreover, they proposed a modified definition of e, which preserves its initial physical meaning and always yields positive values.[4]

This paper has been selected as a paper of editors' suggestion in Physical Review Letters. In addition, their achievement has been often advertised as a good example of the success of BIEP (bilateral international exchange program) in GCOE project “The Next Generation of Physics, Spun from Universality and Emergence ” in Kyoto University. Baecause of this international collaboration, Saitoh and Hayakawa organized an international workshop “ Recent Progress in Physics of Dissipative Particle” in November, 2010 to get together related researchers on this subject all over the world.

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Supersymmetry on 3-sphere: exact results

Naofumi Hama and Kazuo Hosomichi (YITP)

In the area of supersymmetric field theories, major progress have recently been made based on the idea of explicit path-integration using localization principle. For 4D Seiberg-Witten (SW) theories, exact partition functions were computed on Ω background in the pioneering work [1], and more recently on round S^4 [2]. In three dimensions, similar analysis for a class of SUSY gauge theories on S^3 was first made by Kapustin et.al. [3]. Their results have recently been generalized by our work [4] and independently by Jafferis [5] to arbitrary $\mathcal{N}=2$ SUSY gauge theories. The results turned out to have interesting applications in various directions.

It is a non-trivial fact that the notion of global SUSY on flat space can be generalized to curved space such as sphere. But it is possible only when the space admits Killing spinors ε satisfying

$$D_m\varepsilon \;\equiv\; \left(\partial_m+\tfrac{1}{4}\gamma_{ab}\omega_m^{ab}\right)\varepsilon \;=\; \gamma_m\tilde{\varepsilon} \tag{1}$$

for a certain $\tilde{\varepsilon}$. There are four Killing spinors on round S^3, two of which correspond to Poincaré SUSY and the other two to superconformal symmetry. General $\mathcal{N}=2$ SUSY gauge theories on $\mathbb{R}^3$ can thus be transferred to S^3. The constitutent fields form a vectormultiplet associated to the gauge symmetry G and some chiral multiplets labeled by representation of G and $U(1)$ R-charge.

The localization principle states that nonzero contribution to supersymmetric path integral arises only from saddle points where SUSY variation of all the fermions vanishes. For the 3D $\mathcal{N}=2$ theories which are of our interest, it turns out that the saddle points are parametrized by constant values of the vectormultiplet scalar σ, so that we are left with a finite-dimensional integral. Localization principle also guarantees that the value of the integral is invariant under modifications of the action by arbitrary SUSY-exact quantities. Thanks to this fact, the integral over the directions transverse to saddle point locus can be simplified to a Gaussian integral.

The formula for partition functions has been worked out first for the theories on round S^3, but it has been generalized by our recent work [6] to those on ellipsoid,

$$\frac{x_0^2+x_1^2}{\ell^2}+\frac{x_2^2+x_3^2}{\tilde{\ell}^2} \;=\; 1. \tag{2}$$

The result is summarized as follows. The vectormultiplet for gauge symmetry G gives rise to the following integral,

$$\frac{1}{|W|}\int d^r\hat{\sigma}\prod_{\alpha\in\Delta_+}2\sinh(\pi b\alpha\cdot\hat{\sigma})\cdot 2\sinh\frac{\pi\alpha\cdot\hat{\sigma}}{b}, \tag{3}$$

with $b=(\ell/\tilde{\ell})^{\frac{1}{2}}$. Here W is the Weyl group, $\hat{\sigma}=\sqrt{\ell\tilde{\ell}}\sigma$ takes values on the Cartan subalgebra and α runs over the positive root set of G. A chiral multiplet in the representation R of G and R-charge q contributes an additional factor to the integrand,

$$\prod_\rho s_b\left(\tfrac{iQ}{2}(1-q)-\rho\cdot\hat{\sigma}\right), \tag{4}$$

where $Q=b+\frac{1}{b}$, ρ runs over the weights of R and the function s_b is defined by

$$s_b(x) \;\equiv\; \prod_{m,n\in\mathbb{Z}_{\geq 0}}\frac{mb+nb^{-1}+\frac{Q}{2}-ix}{mb+nb^{-1}+\frac{Q}{2}+ix}. \tag{5}$$

Chern-Simons and Feyet-Iliopoulos terms in the original Laglangian also make nonzero contributions to the integrand, which we omit here.

The above result for the partition function on S^3 shows an interesting dependence on R-charges of matters. This led Jafferis to conjecture that the exact R-symmetry in the IR fixed point must be determined so as to minimize the partition function. Thus we have made the first step toward the 3D version of Zamolodchikov's c-theorem.

The formula was also applied to the theory of multiple M2-branes and AdS_4/CFT$_3$ correspondence. Drukker et.al. analyzed it with the techniques of large-N matrix model, and showed that the free energy of multiple M2-brane theory (ABJM model) obeys the expected $N^{3/2}$ scaling at strong coupling [7].

Yet another application is to the AGT conjecture [8] which predicts correspondences between field theories in different dimensions describing the same wrapped M5-branes. Recently, motivated by our analysis of 3D partition functions on certain domain walls in SW theories [9], there appeared several systematic study of 3D gauge theories for M5-branes wrapped on various 3-manifolds $\mathscr{M}_3$. Interestingly, the partition functions for those theories on ellipsoid are believed to agree with Chern-Simons path integrals on $\mathscr{M}_3$.

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Conservation of the nonlinear curvature perturbation in generic single-field inflation

Atsuhi Naruko and Misao Sasaki (YITP)

Thanks to current high precision measurements of the Cosmic Microwave Background (CMB), the nature of temperature anisotropies is revealed that its power spectrum with the very tiny amplitude ($\sim 10^{-5}$) is nearly scale invariant, and its statistics is almost Gaussian. These tiny temperature anisotropies are naturally explained by inflation in the very early universe.

Recently, deviations of CMB from the Gaussian statistics have been attracting much attention. Although we have hundreds of models consistent with current CMB observations, many of them will be excluded if non-Gaussianity is ever detected. To compute the non-Gaussianity, we need to include the nonlinear dynamics of cosmological perturbations.

There are mainly two approaches to nonlinear cosmological perturbations; the standard perturbative approach and the gradient expansion approach. In gradient expansion, the field equations are expanded in powers of spatial gradients and hence this is applicable only to perturbations on superhorizon scales. However, a big advantage is that the amplitude of the perturbation can be fully nonlinear at each order of gradient expansion.

Here, we study the evolution of a curvature perturbation on superhorizon scales in generic single-field inflation. We show that an appropriately defined non-linear curvature perturbation on comoving slices is conserved at leading order in gradient expansion provided that the system is in an attractor regime [1] * .

On superhorizon scales, the metric is expressed as

$$ds^2 = g_{\mu\nu}dx^\mu dx^\nu = -\alpha^2 dt^2 + a^2(t)e^{2\Psi}\delta_{ij}\,dx^i dx^j\,, \quad (1)$$

where $a(t)$ is the scale factor of a fiducial homogeneous universe and Ψ is the nonlinear curvature perturbation at leading order in gradient expansion [2]. We consider the action for a very general Einstein-scalar theory,

$$S = \int d^4x\sqrt{-g}\left[\frac{1}{2\kappa^2}R + W(X,\phi) - G(X,\phi)\Box\phi\right]\,, \quad (2)$$

where $X \equiv -g^{\mu\nu}\partial_\mu\phi\partial_\nu\phi/2$ and $\kappa^2 = 8\pi G_N$. The scalar field equation is

$$\begin{aligned}&\Big(W_{,X} - 2G_{,\phi} + 2G_{,X}K\partial_\tau\phi\Big)\partial_\tau^2\phi \\ &\quad + (\partial_\tau G_{,X})K(\partial_\tau\phi)^2 + G_{,X}(\partial_\tau K + K^2)(\partial_\tau\phi)^2 - W_{,\phi} \\ &\quad + \Big[\partial_\tau(W_{,X} - G_{,\phi}) + K(W_{,X} - 2G_{,\phi})\Big]\partial_\tau\phi = 0\,. \quad (3)\end{aligned}$$

where the spatial derivatives are neglected since we concentrate on superhorizon scales, and $d\tau = \alpha(t,x^k)\,dt$. The volume expansion rate is given by

$$K \equiv \frac{3}{\alpha}\left(\frac{1}{a}\frac{da}{dt} + \partial_t\Psi\right)\,. \quad (4)$$

Here we note that the scalar field equation contains the second time derivative of the metric if $G_{,X} \neq 0$.

Quite generally a conservation law corresponds to an integral of motion. Thus to derive a conservation law, it is necessary for the scalar field equation to be effectively first order. Hence to show the conservation of the nonlinear curvature perturbation, we assume that the system has evolved into an attractor stage so that the time derivative of the scalar field has become a function of ϕ,

$$\partial_\tau\phi = f(\phi)\,. \quad (5)$$

We arrange Eq. (3) in the form, $A(\phi) + KB(\phi) = 0$ where A and B are functions of scalar field given by W, G, f and their derivatives. Integrating Eq. (4) along the integral curve of an observer normal to the time constant hypersurfaces, we obtain

$$\int_{t_\mathrm{i}}^t dt'\alpha K = 3\left[\ln\left(\frac{a(t)}{a(t_\mathrm{i})}\right) + \Psi(t,x^k) - \Psi(t_\mathrm{i},x^k)\right]\,. \quad (6)$$

On the other hand, the integral can also be written as

$$\int_{t_\mathrm{i}}^t dt'\alpha\frac{A(\phi)}{B(\phi)} = \int_{\phi_\mathrm{i}}^\phi d\phi'\frac{A(\phi')}{f(\phi')B(\phi')} = F(\phi) - F(\phi_\mathrm{i})\,. \quad (7)$$

Combining Eqs. (6) and (7), we find

$$-3\left[\ln\left(\frac{a(t)}{a(t_\mathrm{i})}\right) + \Psi(t,x^k) - \Psi(t_\mathrm{i},x^k)\right] = F(\phi) - F(\phi_\mathrm{i})\,, \quad (8)$$

for any t.

Now choose the uniform ϕ slicing, which corresponds to the comoving slicing, we have $\phi\big(\tau(t,x^k),x^k\big) = \phi(t)$. Eq. (8) gives

$$-3\ln\left(\frac{a(t)}{a(t_\mathrm{i})}\right) = F(\phi) - F(\phi_\mathrm{i})\,, \quad \Psi_c(t,x^k) = \Psi_c(t_\mathrm{i},x^k)\,, \quad (9)$$

where Ψ_c is Ψ evaluated on comoving slices. This completes a proof of the conservation of the nonlinear curvature perturbation on comoving slices. The key for the proof is the attractor behaviour of the scalar field, Eq. (5).

*This was chosen as an IOPselect 2011 as well as a CQG Highlight 2010 – 2011.

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2.3 Publications

2.3.1 YITP preprints (January∼December 2010)

10-1 Toshifumi Jittoh, Kazunori Kohri, Masafumi Koike, Joe Sato, Takashi Shimomura, Masato Yamanaka, *Stau relic density at the Big-Bang nucleosynthesis era consistent with the abundance of the light element nuclei in the coannihilation scenario* (January); arXiv:1001.1217v1[hep-ph]

10-2 K.-I. Izawa, Y. Nakai, Ryo Takahashi, *Nonlinearly Realized Extended Supergravity* (January); arXiv:1003.0740v1[hep-ph]

10-3 Kenji Fukushima, Marco Ruggieri, Raoul Gatto, *Chiral magnetic effect in the PNJL model* (January); arXiv:1003.0047v1[hep-ph]

10-4 Antonio Enea Romano, Misao Sasaki, Alexei A. Starobinsky, *Effects of inhomogeneities on apparent cosmological observables: "fake" evolving dark energy* (January); arXiv:1006.4735v1[astro-ph.CO]

10-5 Jinn-Ouk Gong, Seoktae Koh, Misao Sasaki, *A complete analysis of linear cosmological perturbations in Ho?ava-Lifshitz gravity* (February); Phys.Rev.D81:084053,2010 arXiv:1002.1429v1[hep-th]

10-6 Frederico Arroja, Misao Sasaki, *A note on the equivalence of a barotropic perfect fluid with a K-essence scalar field* (February); Phys.Rev.D81:107301,2010 arXiv:1002.1376v1[astro-ph.CO]

10-7 M. Doring, D. Jido, E. Oset, *Helicity Amplitudes of the Lambda(1670) and two Lambda(1405) as dynamically generated resonances* (February); Eur. Phys. J. A 45, 319-333 (2010) arXiv:1002.3688v1[nucl-th]

10-8 Yu-ichi Takamizu, Shinji Mukohyama, Misao Sasaki, Yoshiharu Tanaka, *Non-Gaussianity of superhorizon curvature perturbations beyond δ N formalism* (February); JCAP 1006:019,2010 arXiv:1004.1870v1[astro-ph.CO]

10-9 Daisuke Yamauchi, Yuuiti Sendouda, Chul-Moon Yoo, Keitaro Takahashi, Atsushi Naruko, Misao Sasaki, *Skewness in CMB temperature fluctuations from curved cosmic (super-)strings* (February); arXiv:1004.0600v1[astro-ph.CO]

10-10 Yuichiro Nakai, Yutaka Ookouchi, *Gaugino Mass and Landscape of Vacua* (February); arXiv:1010.5540v1[hep-th]

10-11 Tatsuo Kobayashi, Ryosuke Maruyama, Masaki Murata, Hiroshi Ohki, Manabu Sakai, *Three-generation Models from E_8 Magnetized Extra Dimensional Theory* (February); arXiv:1002.2828v1[hep-ph]

10-12 E. Kaneshita, T. Tohyama, *Spin and Charge Dynamics Ruled by the Antiferromagnetic Order in Iron Pnictides* (February); arXiv:1002.2701v1[cond-mat.supr-con]

10-13 Naoki Sasakura, *Hopf algebra description of quantum circuits* (February); arXiv:1002.3661v2[quant-ph]

10-14 Tohru Eguchi, Kazuhiro Hikami, *N=2 Superconformal Algebra and the Entropy of Calabi-Yau Manifolds* (March); Lett.Math.Phys.92:269-297,2010 arXiv:1003.1555v1[hep-th]

10-15 Leonor Garcia-Gutierrez, Satoru Odake, Ryu Sasaki, *Modification of Crum's Theorem for 'Discrete' Quantum Mechanics* (March); arXiv:1004.0289v1math-ph]

10-16 Jason Doukas, Benedict Carson, *Entanglement of two qubits in a relativistic orbit* (March); arXiv:1003.2201v2[quant-ph]

10-17 Ryu Sasaki, Satoshi Tsujimoto, Alexei Zhedanov, *Exceptional Laguerre and Jacobi polynomials and the corresponding potentials through Darboux-Crum Transformations* (March); arXiv:1004.4711v1[math-ph]

10-18 D. Jido, T. Sekihara, Y. Ikeda, T. Hyodo, Y. Kanada-En'yo, E. Oset, *The nature of Lambda(1405) hyperon resonance in chiral dynamics* (March); Nuclear Physics, Section A 835 (2010), pp. 59-66 arXiv:1003.4560v1[nucl-th]

10-19 Satoru Odake, Ryu Sasaki, *Exceptional Askey-Wilson type polynomials through Darboux-Crum transformations* (March); arXiv:1004.0544v1[math-ph]

10-20 Tohru Eguchi, Hirosi Ooguri, Yuji Tachikawa, *Notes on the K3 Surface and the Mathieu group $M_2$4* (March); arXiv:1004.0956v1[hep-th]

10-21 Kohta Murase, John F. Beacom, *Very-High-Energy Gamma-Ray Signal from Nuclear Photodisintegration as a Probe of Extragalactic Sources of Ultrahigh-Energy Nuclei* (March); arXiv:1002.3980v1[astro-ph.HE]

10-22 Kohta Murase, John F. Beacom, *Neutrino Background Flux from Sources of Ultrahigh-Energy Cosmic-Ray Nuclei* (March); Phys.Rev.D 81 (2010) 123001 arXiv:1003.4959v1[astro-ph.HE]

10-23 Antonino Flachi, Guglielmo Fucci, *Zeta Determinant for Laplace Operators on Riemann Caps* (March); J. Math. Phys.52:023503,2011 arXiv:1004.0063v1 [math-ph]

10-24 Taichiro Kugo, Tsutomu T. Yanagida, *Coupling Supersymmetric Nonlinear Sigma Models to Supergravity* (March); Prog.Theor.Phys.124:555-

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10-25 David Wands, *Local non-Gaussianity from inflation* (March); arXiv:1004.0818v1[astro-ph.CO]

10-26 José Fonseca, Misao Sasaki, David Wands, *Large-scale Perturbations from the Waterfall Field in Hybrid Inflation* (March); arXiv:1005.4053v1[astro-ph.CO]

10-27 Christian T. Byrnes, Mischa Gerstenlauer, Sami Nurmi, Gianmassimo Tasinato, David Wands, *Scale-dependent non-Gaussianity probes inflationary physics* (March); arXiv:1007.4277v1[astro-ph.CO]

10-28 Kenji Fukushima, Tetsuo Hatsuda, *The phase diagram of dense QCD* (April); arXiv:1005.4814v1[hep-ph]

10-29 Yuichiro Nakai, Manabu Sakai, *Inflation and Gauge Mediation in Supersymmetric QCD* (April); arXiv:1004.2099v1[hep-ph]

10-30 Charles A. S. Young, Robin Zegers, *On q,t-characters and the l-weight Jordan filtration of standard quantum affine sl2 modules* (April); arXiv:1004.2321v1[math.QA]

10-31 Kenji Fukushima, Marco Ruggieri, *Dielectric correction to the Chiral Magnetic Effect* (April); arXiv:1004.2769v1[hep-ph]

10-32 Takahiro Tanaka, Teruaki Suyama, Shuichiro Yokoyama, *Use of delta N formalism - Difficulties in generating large local-type non-Gaussianity during inflation -* (April); arXiv:1003.5057v2[astro-ph.CO]

10-33 Ryu Sasaki, *Exactly and quasi-exactly solvable 'discrete' quantum mechanics* (April); arXiv:1004.4712v1[math-ph]

10-34 Chul-Moon Yoo, Ken-ichi Nakao, Misao Sasaki, *CMB observations in LTB universes: Part I: Matching peak positions in the CMB spectrum* (April); arXiv:1005.0048v1[astro-ph.CO]

10-35 Keiju Murata, Shunichiro Kinoshita, Norihiro Tanahashi, *Non-equilibrium Condensation Process in a Holographic Superconductor* (April); JHEP 1007:050,2010 arXiv:1005.06p33v1[hep-th]

10-36 P. K. Sahu, K. Tsubakihara, A. Ohnishi, *Nuclear Matter and Finite Nuclei in the Effective Chiral Model* (May); Phys.Rev.C81:014002,2010 arXiv:0912.1416v1[nucl-th]

10-37 Naoki Sasakura, *A renormalization procedure for tensor models and scalar-tensor theories of gravity* (May); arXiv:1005.3088v1[hep-th]

10-38 Yasuyuki Hatsuda, Katsushi Ito, Kazuhiro Sakai, Yuji Satoh, *Six-point gluon scattering amplitudes from Z_4-symmetric integrable model* (May); arXiv:1005.4487v1[hep-th]

10-39 Isao Kishimoto, Sanefumi Moriyama, *An Algebraic Model for the su(2—2) Light-Cone String Field Theory* (May); arXiv:1005.4719v1[hep-th]

10-40 Tohru Eguchi, Kazunobu Maruyoshi, *Seiberg-Witten theory, matrix model and AGT relation* (May); arXiv:1006.0828v2[hep-th]

10-41 Tatsuo Kobayashi, Takashi Shimomura, *Constraints from Color and/or Charge Breaking Minima in the νSSM* (May); arXiv:1006.0062v1[hep-ph]

10-42 Leonardo Campanelli, Marco Ruggieri, *Non-topological Domain Walls in a Model with Broken Supersymmetry* (May); arXiv:1005.4824v1[hep-th]

10-43 Kunihiko Terasaki, *Tetra-quark Systems in Heavy Mesons* (May); arXiv:1005.5573v1[hep-ph]

10-44 Daisuke Yamauchi, Keitaro Takahashi, Yuuiti Sendouda, Chul-Moon Yoo, Misao Sasaki, *Analytical model for CMB temperature angular power spectrum from cosmic (super-)strings* (); May arXiv:1006.0687v1[astro-ph.CO]

10-45 Kazunobu Maruyoshi, Masato Taki, *Deformed Prepotential, Quantum Integrable System and Liouville Field Theory* (June); arXiv:1006.4505v1[hep-th]

10-46 Kenji Fukushima, *Phase diagram of hot and dense QCD constrained by the Statistical Model* (June); arXiv:1006.2596v1[hep-ph]

10-47 Tatsuo Kobayashi, Yuichiro Nakai, Ryo Takahashi, *Revisiting superparticle spectra in superconformal flavor models* (June); arXiv:1006.4042v1[hep-ph]

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10-49 Antonio De Felice, Takahiro Tanaka, *Inevitable ghost and the degrees of freedom in f(R,G) gravity* (June); Prog. Theor. Phys. 124 (2010), 503-515 arXiv:1006.4399v2[astro-ph.CO]

10-50 Todd Springer, Charles Gale, Sangyong Jeon, Su Houng Lee, *A shear spectral sum rule in a non-conformal gravity dual* (June); arXiv:1006.4667v2[hep-th]

10-51 A. Nishiyama, A. Ohnishi, *Entropy current for the relativistic Kadanoff-Baym equation and H-theorem in $O(N)$ theory with NLO self-energy of $1/N$ expansion* (June); Prog. Theor. Phys. 126: 249-267,2011 arXiv:1006.1124v1[nucl-th]

10-52 H. Matsumiya, K. Tsubakihara, M. Isaka, M. Kimura, A. Doté and A. Ohnishi, *Spin-dependence of the -N interaction and the hypernuclear production spectrum* (June); Nuclear Physics A835 (2010)366-369

10-53 K. Sumiyoshi, K. Nakazato, C. Ishizuka, A. Ohnishi, S. Yamada, H. Suzuki, *Emergence of hyperons in failed supernovae with short neutrino bursts* (June); Nuclear Physics A835 (2010)295-302

10-54 A. Ohnishi, K. Tsubakihara, K. Sumiyoshi, C. Ishizuka, S. Yamada, H. Suzuki, *EOS of hyperonic matter for core-collapse supernovae* (June); Nuclear Physics A835 (2010) 374-377

10-55 Raoul Gatto, Marco Ruggieri, *Dressed Polyakov loop and phase diagram of hot quark matter under magnetic field* (July); arXiv:1007.0790v1[hep-ph]

10-56 Yuko Urakawa, Takahiro Tanaka, *IR divergence does not affect the gauge-invariant curvature perturbation* (July); Phys.Rev.D82:121301,2010 arXiv:1007.0468v2[hep-th]

10-57 Masato Taki, *Surface Operator, Bubbling Calabi-Yau and AGT Relation* (July);

arXiv:1007.2524v1[hep-th]

10-58 Tetsuo Hyodo, Daisuke Jido, Teiji Kunihiro, *Nature of the sigma meson as revealed by its softening process* (July); arXiv:1007.1718v1[hep-ph]

10-59 N. Itagaki, Tz. Kokalova, and W. von Oertzen, *Three- state around 40Ca* (July); Physical Review C82, 014312(2010)

10-60 K.Horii, M.Takashina, T.Furumoto, Y.Sakuragi, and H.Toki, *Elastic scattering of 8B from 12C with internal three-cluster structure of 8B* (July); Physical Review C81, 061602(2011)

10-61 Nathalie Deruelle, Misao Sasaki, *Conformal equivalence in classical gravity: the example of "veiled" General Relativity* (July); arXiv:1007.3563v1[gr-qc]

10-62 Michael Creutz, Tatsuhiro Misumi, *Classification of Minimally Doubled Fermions* (July); arXiv:1007.3328v1[hep-lat]

10-63 Yoshinori Matsuo, Takuya Tsukioka, Chul-Moon Yoo, *Notes on the Hidden Conformal Symmetry in the Near Horizon Geometry of the Kerr Black Hole* (July); Nucl.Phys.B844:146-163,2011 arXiv:1007.3634v1[hep-th]

10-64 Satoru Odake, Ryu Sasaki, *A new family of shape invariantly deformed Darboux-Pöschl-Teller potentials with continuous ℓ* (July); arXiv:1007.3800v1[math-ph]

10-65 Yoshimi Kanehata, Tatsuo Kobayashi, Yasufumi Konishi, Takashi Shimomura, *Constraints from Unrealistic Vacua in Supersymmetric Standard Model with Neutrino Mass Operators* (July); Phys.Rev.D82:075018,2010 arXiv:1008.0593v1[hep-ph]

10-66 Kenji Fukushima, Kazuhiko Kamikado, Bertram Klein, *Second-order and Fluctuation-induced First-order Phase Transitions with Functional Renormalization Group Equations* (July); Phys.Rev.D83:116005,2011 arXiv:1010.6226v1[hep-ph]

10-67 Chul-Moon Yoo, Ken-ichi Nakao, Misao Sasaki, *CMB observations in LTB universes: Part II – the kSZ effect in an LTB universe* (July); arXiv:1008.0469v1[astro-ph.CO]

10-68 A. Martinez Torres, D. Jido, *Studying $K\Lambda(1405)$ aspect of the $K\bar{K}N$ system* (August); arXiv:1008.0457v1[nucl-th]

10-69 Kunihiko Terasaki, *Tetra-quark mesons with exotic quantum numbers* (August); arXiv:1008.2992v1[hep-ph]

10-70 Antoine Calvez, Alexander Kusenko, Shigehiro Nagataki, *Role of Galactic sources and magnetic fields in forming the observed energy-dependent composition of ultrahigh-energy cosmic rays* (August); Phys. Rev. Lett. 105, 091101 (2010) arXiv:1004.2535v4[astro-ph.HE]

10-71 D. Jido, E. Oset, T. Sekihara, *Kaon induced Lambda(1405) production on a deuteron target at DAFNE* (August); arXiv:1008.4423v1[nucl-th]

10-72 Takayasu Sekihara, Alberto Martinez Torres, Daisuke Jido, Eulogio Oset, *Theoretical study of incoherent phi photoproduction on a deuteron target* (August); arXiv:1008.4422v1 [nucl-th]

10-73 K.-I. Izawa, T. Kugo, T.T. Yanagida, *Gravitational Supersymmetry Breaking* (August); Prog.Theor.Phys.125:261-264,2011 arXiv:1008.4641v1[hep-ph]

10-74 Tohru Eguchi, Kazuhiro Hikami, *Note on Twisted Elliptic Genus of K3 Surface* (August); Phys.Lett.B694:446-455,2011 arXiv:1008.4924v2[hep-th]

10-75 Maiko Kohriki, Hiroshi Kunitomo, Masaki Murata, *No-ghost Theorem for Neveu-Schwarz string in 0-picture* (August); arXiv:1009.0107v1[hep-th]

10-76 Kazuo Hosomichi, Sungjay Lee, Jaemo Park, *AGT on the S-duality Wall* (August); arXiv:1009.0340v1[hep-th]

10-77 T. Kunihiro, B. Müller, A. Ohnishi, A. Schäfer, T. T. Takahashi, A Yamamoto, *Chaotic behavior in classical Yang-Mills dynamics* (September); Phys.Rev.D82:114015,2010 arXiv:1008.1156v1[hep-ph]

10-78 Takashi Z. Nakano, Kohtaroh Miura, Akira Ohnishi, *Chiral and deconfinement transitions in strong coupling lattice QCD with finite coupling and Polyakov loop effects* (September); arXiv:1009.1518v1[hep-lat]

10-79 Yohsuke Takamori, Ken-ichi Nakao, Hideki Ishihara, Masashi Kimura, Chul-Moon Yoo, *Perturbative Analysis of a Stationary Magnetosphere in an Extreme Black Hole Spacetime : On the Meissner-like Effect of an Extreme Black Hole* (September); arXiv:1010.4104v1[gr-qc]

10-80 Chul-Moon Yoo, *A Note on the Inverse Problem with LTB Universes* (September); arXiv:1010.0530v1[astro-ph.CO]

10-81 Yuko Urakawa, Takahiro Tanaka, *Natural selection of inflationary vacuum required by infrared regularity and gauge-invariance* (September); arXiv:1009.2947v1[hep-th]

10-82 Jinn-Ouk Gong, Misao Sasaki, *Waterfall field in hybrid inflation and curvature perturbation* (September); JCAP 1103:028,2011 arXiv:1010.3405v3[astro-ph.CO]

10-83 A. Martinez Torres, E. Oset, *An alternative explanation for the $\Theta(1540)$ pentaquark peak* (September); arXiv:1012.2967v1[nucl-th]

10-84 Kazunobu Maruyoshi, Futoshi Yagi, *Seiberg-Witten curve via generalized matrix model* (September); arXiv:1009.5553v1[hep-th]

10-85 Hiroyuki Abe, Kang-Sin Choi, Tatsuo Kobayashi, Hiroshi Ohki, Manabu Sakai, *Non-Abelian Discrete Flavor Symmetries on Orbifolds* (September); Int.J.Mod.Phys.A26:4067-4082,2011 arXiv:1009.5284v1[hep-th]

10-86 Jason Doukas, *Exact constraints on $D\leq 10$ Myers Perry black holes* (September); arXiv:1009.6118v1[hep-th]

10-87 Chul-Moon Yoo, Tomohiro Kai, Ken-ichi Nakao, *Redshift Drift in LTB Void Universes* (September); Phys.Rev.D83:043527,2011 arXiv:1010.0091v1[astro-ph.CO]

10-88 Daisuke Jido, *Pseudoscalar mesons in nuclei and partial restoration of chiral symmetry* (October); Prog.of Theor. Phys., Suppl. 186 (2010) 294-299 arXiv:1012.3497v1[nucl-th]

10-89 Tatsuo Azeyanagi, Noriaki Ogawa, Seiji Terashima, *Emergent AdS_3 in the Zero Entropy Extremal Black Holes* (October); arXiv:1010.4291v1[hep-th]

10-90 Judit Romhanyi, Keisuke Totsuka, Karlo Penc, *The effect of Dzyaloshinskii-Moriya interactions on the phase diagram and magnetic excitations of SrCu2(BO3)2* (October); arXiv:1010.4476v1[cond-mat.str-el]

10-91 Shin'ichi Nojiri, Sergei D. Odintsov, Misao Sasaki, Ying-li Zhang, *Screening of cosmological constant in non-local gravity* (October); Phys.Lett.B696:278-282,2011 arXiv:1010.5375v1[gr-qc]

10-92 T. Furumoto, Y. Sakuragi, Y. Yamamoto, *Repulsive nature of optical potentials for high-energy heavy-ion scattering* (October); Phys.Rev.C82:044612,2010 arXiv:1010.1661v1[nucl-th]

10-93 Michael Creutz, Taro Kimura, Tatsuhiro Misumi, *Index Theorem and Overlap Formalism with Naive and Minimally Doubled Fermions* (November); JHEP 1012:041,2010 arXiv:1011.0761v1[hep-lat]

10-94 Tohru Eguchi, Yuji Sugawara, *Non-holomorphic Modular Forms and SL(2,R)/U(1) Superconformal Field Theory* (November); arXiv:1012.5721v1[hep-th]

10-95 A. Martinez Torres, E.J. Garzon, E. Oset, L. R. Dai, *The fixed center approximation to Faddeev equations in connection to the X(2175) resonance* (November); arXiv:1012.2708v1[hep-ph]

10-96 Raoul Gatto, Marco Ruggieri, *Deconfinement and Chiral Symmetry Restoration in a Strong Magnetic Background* (November); arXiv:1012.1291v1[hep-ph]

10-97 Tatsuo Kobayashi, Manabu Sakai, *Inflation, moduli (de)stabilization and supersymmetry breaking* (December); arXiv:1012.2187v1[hep-th]

10-98 Seiji Terashima, Futoshi Yagi, *On Effective Action of Multiple M5-branes and ABJM Action* (December); arXiv:1012.3961v1[hep-th]

10-99 Takayasu Sekihara, Tetsuo Hyodo, Daisuke Jido, *Internal structure of resonant Lambda(1405) state in chiral dynamics* (December); arXiv:1012.3232v1[nucl-th]

10-100 Naofumi Hama, Kazuo Hosomichi, Sungjay Lee, *Notes on SUSY Gauge Theories on Three-Sphere* (December); arXiv:1012.3512v1[hep-th]

10-101 N. Itagaki, J. Cseh, M. Ploszajczak, *Simplified modeling of cluster-shell competition in ^{20}Ne and ^{24}Mg* (December); Phys.Rev.C83:014302,2011 arXiv:1012.3794v1[nucl-th]

10-102 Antonino Flachi, Takahiro Tanaka, *Chiral Modulations in Curved Space I: Formalism* (December); JHEP 1102:026,2011 arXiv:1012.0463v2[hep-th]

10-103 Takatoshi Ichikawa, Akira Iwamoto, *Calculations of Branching Ratios for Radiative-Capture, One-Proton, and Two-Neutron Channels in the Fusion Reaction $^{209}Bi+^{70}Zn$* (December); J. Phys. Soc. Jpn. 79, 074201 (2010) arXiv:1012.4310v1[nucl-th]

10-104 Takatoshi Ichikawa, Yoshiko Kanada-En'yo, Peter Müller, *Cluster formations in deformed states for ^{28}Si and ^{32}S* (December); arXiv:1012.4311v1[nucl-th]

10-105 Nathalie Deruelle, Misao Sasaki, Yuuiti Sendouda, Ahmed Youssef, *Inflation with a Weyl term, or ghosts at work* (December); JCAP 1103:040,2011 arXiv:1012.5202v1[gr-qc]

10-106 Nathalie Deruelle, Misao Sasaki, *Conformal transformations and Nordström's scalar theory of gravity* (December); arXiv:1012.5386v1[gr-qc]

10-107 A. Andronic, D. Blaschke, P. Braun-Munzinger, J. Cleymans, K. Fukushima, L.D. McLerran, H. Oeschler, R.D. Pisarski, K. Redlich, C. Sasaki, H. Satz, J. Stachel, *Hadron Production in Ultra-relativistic Nuclear Collisions: Quarkyonic Matter and a Triple Point in the Phase Diagram of QCD* (December); arXiv:0911.4806v3[hep-ph]

10-108 Kenji Fukushima, Dmitri E. Kharzeev, Harmen J. Warringa, *Real-time dynamics of the Chiral Magnetic Effect* (December); arXiv:1002.2495v1[hep-ph]

10-109] Ju-Jun Xie, A. Martinez Torres, E. Oset, P. Gonzalez, *A plausible explanation of the $\Delta_{5/2^+}(2000)$ puzzle* (December); Phys.Rev.C83:055204,2011 arXiv:1101.1722v1[nucl-th]

10-110 Takashi Hiramatsu, Masahiro Kawasaki, Ken'ichi Saikawa, *Evolution of String-Wall Networks and Axionic Domain Wall Problem* (December); arXiv:1012.4558v1[astro-ph.CO]

10-111 Takashi Hiramatsu, Masahiro Kawasaki, Toyokazu Sekiguchi, Masahide Yamaguchi, Jun'ichi Yokoyama, *Improved estimation of radiated axions from cosmological axionic strings* (December); arXiv:1012.5502v1[hep-ph]

10-112 The energy of the analytic lump solution in SFT, *L.Bonora, S.Giaccari, D.D.Tolla* (December); arXiv:1105.5926v1[hep-th]

10-113 Loriano Bonora, Maro Cvitan, Predrag Dominis Prester, Silvio Pallua, Ivica Smolić?, *Gravitational Chern-Simons Lagrangians and black hole entropy* (December); arXiv:1104.2523v1[hep-th]

10-114 Takashi Z. Nakano, Kohtaroh Miura, Akira Ohnishi, *Effective Potential and Phase Diagram in the Strong-Coupling Lattice QCD with Next-to-Next-to-Leading Order and Polyakov Loop Effects* (December); arXiv:1010.5687v1[hep-lat]

10-115 Kohtaroh Miura, Takashi Z. Nakano, Akira Ohnishi, Noboru Kawamoto, *Chiral and deconfinement transitions in strong coupling lattice QCD* (December); arXiv:1012.1509v1[hep-lat]

10-116 Akihiro Nishiyama, Akira Ohnishi, *En-*

tropy Production in Gluodynamics in temporal axial gauge in 2+1 dimensions (December); arXiv:1011.4750v1[nucl-th]

10-117 Sungtae Cho, Takenori Furumoto, Tetsuo Hyodo, Daisuke Jido, Che Ming Ko, Su Houng Lee, Marina Nielsen, Akira Ohnishi, Takayasu Sekihara, Shigehiro Yasui, Koichi Yazaki (the ExHIC collaboration), *Multi-quark hadrons from Heavy Ion Collisions* (December); arXiv:1011.0852v1[nucl-th]

10-118 Kouki Nakata, Keisuke Totsuka, *Extended Quantum Dimer Model and novel valence-bond phases* (December); J. Stat. Mech. (2011) P01033 arXiv:1101.2111v1 [cond-mat.str-el]

2.3.2 Publications and Talks by Regular Staff (April 2010 — March 2011)

Tohru Eguchi

Journal Papers

1. T. Eguchi,Y. Sugawara
"Non-holomorphic Modular Forms and SL(2,R)/U(1) Superconformal Field Theory," JHEP 1103 (2011) 107, arXiv:1012.5721[hep-th].
2. T. Eguchi,K. Hikami
"Note on Twisted Elliptic Genus of K3 Surface,"
Phys.Lett. B694 (2011) 446-455, YITP-10-74, arXiv:1008.4924[hep-th].
3. T. Eguchi, K. Maruyoshi,
"Seiberg-Witten theory, matrix model and AGT relation,"
JHEP 1007 (2010) 081, YITP-10-40, arXiv:1006.0828[hep-th].
4. T. Eguchi, H. Ooguri, Y. Tachikawa,
"Notes on the K3 Surface and the Mathieu group M24,"
Exper.Math. 20 (2011) 91-96, YITP-10-20, arXiv:1004.0956 [hep-th].

Talks at International Conferences

1. "Elliptic Genus of K3 Surface and Mathieu Group," Invited
in "Symplectic geometry, non-Commutative Geometry and Physics", MSRI, UC Berkeley, U.S.A.,
May 2010.

Invited Seminars (in Japan)

1. "Seiberg-Witten Theory and AGT Relation,"
Yukawa Institute workshop "Frontiers of Field theory and of String theory" Kyoto Univ. July 2010.
2. "Elliptic genus of K3 Surface and Mathieu Group M24",
Summer Institute 2010, Fuji yoshida, July 2010.
3. "Elliptic Genus of K3 Surface and Mathieu Group",
workshop at Nagoya University, February, 2011.

Hisao Hayakawa

Journal Papers

1. Kuniyasu Saitoh, Anna Bodrova, Hisao Hayakawa, and Nikolai V. Brilliantov,
"Negative Normal Restitution Coefficient Found in Simulation of Nanocluster Collisions,"
Phys. Rev. Lett. **105** (2010) 238001 (4 pages).
2. Song-Ho Chong, Michio Otsuki and Hisao Hayakawa,
"Representation of the Nonequilibrium Steady-State Distribution Function for Sheared Granular Systems,"
Prog. Theor. Phys. Suppl. No. **184** (2010) 72 (16 pages).
3. Michio Otsuki, Hisao Hayakawa and Stefan Luding,
"Behavior of Pressure and Viscosity at High Densities for Two-Dimensional Hard and Soft Granular Materials"
Prog. Theor. Phys. Suppl. No. **184** (2010) 110 (24 pages).
4. Hisao Hayakawa,
"Generalized Green-Kubo Formula for a Dissipative Quantum System ,"
Prog. Theor. Phys. Suppl. No. **184** (2010) 545 (12 pages).
5. Song-Ho Chong, Michio Otsuki and Hisao Hayakawa,
"Generalized Green-Kubo relation and integral fluctuation theorem for driven dissipative systems without microscopic time reversibility ,"
Phys. Rev. E. **81** (2010) 041130 (4 pages).
6. Kuniyasu Saitoh and Hisao Hayakawa,
"Motion of a free-standing graphene sheet induced by a collision with an argon nanocluster: Analyses of the detection and heat-up of the graphene "
Phys. Rev. E **81** (2010) 115447 (5 pages).

Talks at International Conferences

1. "Nonequilibrium mode coupling theory of sheared granular liquids," Invited,
in Gordon Research Conference "Granular and Granular Fluid Flow," Colby College, ME, USA,
June 2010.
2. "Fluctuation theorem and generalized Green-Kubo formula for quantum dissipative systems ,"
in Physics and chemistry in quantum dissipative systems, YITP, Kyoto University, Japan
August 2010.
3. "General Nonsense Approach of Dissipative Systems ? Fluctuation theorem and

generalized Green-Kubo formula-,", Invited

in Dynamics of the Glass/Jamming Transition, Busan, Korea
September 2010 .

4. "Fluctuation theorem for system of dissipative particles," Invited,
in "Recent progress in physics of dissipative particles," YITP, Kyoto University, Japan, November 2010.
5. "Fluctuation theorem and generalized Green-Kubo formula for quantum dissipative systems,"
in DSMQ, the University of Tokyo, Japan
February 2011.

Invited Seminars (Overseas)

1. "Scaling theory of jamming transition,"
at Clark University, MA, USA, June 2010.

Invited Seminars (in Japan)

1. "Electric conduction in the molecular dynamics simulation of a non-degenerate 2D electron system in a point-contact device,"
with Moto Araki, Riken, December 2010.

Kazuo Hosomichi

Journal Papers

1. N. Hama, K. Hosomichi and S. Lee, "SUSY Gauge Theories on Squashed Three-Spheres," JHEP **1105**, 014 (2011), 23 pages. arXiv:1102.4716 [hep-th].
2. N. Hama, K. Hosomichi and S. Lee, "Notes on SUSY Gauge Theories on Three-Sphere," JHEP **1103**, 127 (2011), 14 pages. arXiv:1012.3512 [hep-th].
3. K. Hosomichi, S. Lee and J. Park, "AGT on the S-duality Wall," JHEP **1012**, 079 (2010), 15 pages. arXiv:1009.0340 [hep-th].

Talks at International Conferences

1. "Recent Developments in Superstring Theory,"
Plenary, 2010 Global-COE Symposium, Kyoto Univ., February 2011.
2. "A Virasoro Symmetry Hidden in 4D Gauge Theories,"
Invited, Plenary, 66th Annual JPS meeting, Niigata Univ., March 2011. (canceled due to the earthquake.)

Invited Seminars (Overseas)

1. "AGT on the S-duality Wall,"
SISSA, Italy, March 2011.

Invited Seminars (in Japan)

1. "Liouville Theory and all that,"
Intensive lectures, Tokyo Inst. Tech., July 2010.
2. "AGT correspondence and domain walls,"
2nd String Theory Meeting at RIKEN, September 2010.

Naoyuki Itagaki

Journal Papers

1. Y. Iwata, T. Otsuka, J.A. Maruhn, and N. Itagaki, "Geometric classification of nucleon transfer at intermediate energies," Nucl. Phys. A **836** (2010) 108-118.
2. A.S. Umar, J.A. Maruhn, N. Itagaki, and V.E. Oberacker, "Microscopic study of the triple-alpha reaction," Phys. Rev. Lett. **104** 212503 (2010) 1-4.
3. Y. Iwata, T. Otsuka, J.A. Maruhn, N. Itagaki, "Suppression of Charge Equilibration leading to the Synthesis of Exotic Nuclei," Phys. Rev. Lett. **104** 252501 (2010) 1-4.
4. N. Itagaki, Tz. Kokalova, and W. von Oertzen, "Three-alpha state around ^{40}Ca," Phys. Rev. C **82** 014312 (2010) 1-4, YITP-10-59.
5. N. Itagaki, M. Ploszajczak, and J. Cseh, "Simplified modeling of cluster-shell competition in ^{20}Ne and ^{24}Mg," Phys. Rev. C **83** 014302 (2011) 1-12, YITP-10-101.
6. T. Yoshida, N. Itagaki and K. Katō, "Symplectic structure and monopole strength in ^{12}C," Phys. Rev. C **83** 024301 (2011) 1-8, YITP-11-2.

Books and Proceedings

1. S. Aoyama, N. Itagaki, "Di-neutron correlations in the super neutron-rich nucleus; ^{7}H," Modern Physics Letters A **25** 21-23 (2010) 1828-1832.
2. J.A. Maruhn, N. Loebl, A.S. Umar, et al., "Linear-chain structure of three-α-clusters in ^{12}C, ^{16}C, and ^{20}C" Modern Physics Letters A **25** 21-23 (2010) 1866-1869.
3. N. Itagaki, Tz. Kokalova, W. von Oertzen, "Three α state around ^{40}Ca," Modern Physics Letters A **25** 21-23 (2010) 1947-1950.

Talks at International Conferences

1. "3α cluster state around ^{40}Ca," Invited,
in 2nd Workshop on "State of the Art in Nuclear Cluster Physics," Free University, Brussels, Belgium,
May 2010.

2. “Geometric and gas-like cluster structure in light nuclei,” Invited,
   in a mini Workshop on “Nuclear Symmetry Energy and KoRIA”, Yonsei University, Seoul, Korea,
   October 2010.

Invited Seminars (Overseas)

1. “Specific structure of light neutron-rich nuclei,”
   ATOMKI, Hungary, June 2010.

Invited Seminars (in Japan)

1. “Specific structure of light neutron-rich nuclei,”
   Dept. of Phys., Osaka City Univ., July 2010.
2. “Appearance of geometric cluster states in light neutron-rich nuclei,”
   YITP colloquium, July 2010.
3. “Geometric and gas-like cluster structure of light nuclei,”
   RCNP Osaka Univ., December 2010.
4. “Geometric and gas-like cluster structure in light nuclei,”
   RIKEN, December 2010.

Ken-Iti Izawa

Journal Papers

1. K.-I. Izawa, T. Kugo and T.T. Yanagida, “Gravitational Supersymmetry Breaking,” Prog. Theor. Phys.**125** (2011) 261-264, YITP-10-73, arXiv:1008.4641 [hep-ph].

Invited Seminars (in Japan)

1. “Extended Supersymmetry as a Natural Law,”
   Dept. of Phys., Univ. of Tokyo, June 2010.

Daisuke JIDO

Journal Papers

1. D. Jido, E. Oset, T. Sekihara, “Kaon induced Lambda(1405) production on a deuteron target at DAFNE”, Eur. Phys. J. **A47** (2011) 42 (7 pages), arXiv:1008.4423 [nucl-th], YITP-10-71.
2. A. Martines Torres, D._Jido, “$K\Lambda(1405)$ configuration of the $K\bar{K}N$ system”, Phys. Rev. **C82** (2010) 038202 (4 pages), arXiv:1008.0457 [nucl-th], YITP-10-68.
3. Tetsuo Hyodo, Daisuke Jido, Teiji Kunihiro, “Nature of the σ meson as revealed by its softening process”, Nucl. Phys. **A848** (2010) 341-365, arXiv:1007.1718 [hep-ph], YITP-10-58.
4. M. Doring, D. Jido, E. Oset, “Helicity amplitudes of the $\Lambda(1670)$ and two $\Lambda(1405)$ as dynamically generated resonances”, Eur. Phys. J. **A45** (2010) 319-333, arXiv:1002.3688 [nucl-th], YITP-10-7.
5. D. Cabrera, D. Jido, R. Rapp, L. Roca, “The $a_1(1260)$ as a $\rho\pi$ resonance in nuclear matter”, Prog. Thero. Phys. **123** (2010) 719-742, arXiv:0911.1235 [nucl-th], YITP-09-67.

Books and Proceedings

1. Tetsuo Hyodo, Daisuke Jido, Atsushi Hosaka, “Compositeness of bound states in chiral unitary approach”, AIP Conference Proceedings 1322 (2010) 374-378, arXiv:1009.5754 [nucl-th].
2. T. Sekihara, J. Yamagata-Sekihara, D. Jido, Y. Kanada-En’yo, “Mesonic and non-mesonic absorption of kaon in nuclear matter and $\Lambda(1405)$ doorway process”, AIP Conference Proceedings 1322 (2010) 339-343.
3. D. Cabrera, D. Jido, R. Rapp, L. Roca, “Axial-vector resonance in nuclear matter”, AIP Conference Proceedings 1322 (2010) 90-98.
4. Satoru Hirenzaki, Hideko Nagahiro, Daisuke Jido, “Formation of η mesic nuclei at JPARC and COSY”, AIP Conference Proceedings 1322 (2010) 28-35.
5. Satoru Hirenzaki, Hideko Nagahiro, Daisuke Jido, “Formation of mesic nuclei”, Acta. Phys. Polon. **B41** (2010) 2211-2220,
   arXiv:1011.0867 [nucl-th]
6. Satoru Hirenzaki, Hideko Nagahiro, Daisuke Jido, “A theoretical model for formation of η-^{4}He bound state by d+d reaction”, Int J. Mod. Phys. **A26** (2011) 444-449.
7. Daisuke Jido, “Pseudoscalar mesons in nuclei and partial restoration of chiral symmetry”, Prog. Theor. Phys. Suppl. **186** (2010) 294-299, arXiv:1012.3497 [nucl-th], YITP-10-88.

8. Philipp Gubler, Daisuke Jido, Toru Kojo, Tetsuo Nishikawa, Makoto Oka, “Possible quantum numbers of $\Theta^+(1540)$ in QCD sum rules”, Prog. Theor. Phys. Suppl. **186** (2010) 193-198.
9. T. Hyodo, D. Jido, T. Kunihiro, “Structure of the σ meson and the softening”, *Hadron and Nuclear Physics*, 76-85, World Scientific, 2010, arXiv:1007.2031 [hep-ph].
10. H. Nagahiro, D. Jido, S. Hirenzaki, “Formation of η-mesic nuclei by (π,N) reaction at J-PARC”, *Hadron and Nuclear Physics*, 141-149, World Scientific, 2010.
11. D. Jido, T. Sekihara, Y. Ikeda, T. Hyodo, Y. Kanada-En’yo, E. Oset, “The nature of $\Lambda(1405)$ hyperon resonance in chiral dynamics”, Nucl. Phys. **A835** (2010) 59-66, arXiv:1003.4560 [nucl-th], YITP-10-18.
12. Takayasu Sekihara, Daisuke Jido, Yoshiko Kanada-En’yo, “$\Lambda(1405)N \to YN$ transition in nuclear medium for non-mesonic absorption of $\bar{K}$ in nucleus”, Nucl. Phys. **A835** (2010) 390-393,
13. Tetsuo Hyodo, Daisuke Jido, Atshushi Hosaka, “Meson-baryon nature of $\Lambda(1405)$ in chiral dynamics”, Nucl. Phys. **A835** (2010) 402-405,
14. Philipp Gubler, Daisuke Jido, Toru Kojo, Tetsuo Nishikawa, Makoto Oka, “$S = +1$ pentaquarks in QCD sum rules”, Nucl. Phys. **A835** (2010) 342-345.

Talks at International Conferences

1. “$\Lambda(1405)$ and Kaonic Few-body States in Chiral Dynamics”, invited, plenary, International conference on the structure of baryons (Baryons’10), 7 – 11 December, 2010, Osaka University, Osaka, Japan.
2. “Baryon resonance in chiral dynamics –Kaonic few-body systems–”, invited, plenary, GCOE summer school on hadron and nuclei under extreme conditions (HANEC10), 16 – 17 September, 2010, Tokyo Institute of Technology, Tokyo, Japan.
3. “Chiral symmetry for hadrons in nuclei”, invited, plenary, International Workshop on Chiral Symmetry in Hadrons and Nuclei (Chiral 10), 21 – 24 June, 2010, Instituto de Fisica Corpuscular, Valencia, Spain.

Invited Seminars (Overseas)

1. “$\Lambda(1405)$ in coupled-channels chiral dynamics”, Universidad Complutense de Madrid, Madrid, Spain, 30 June 2010.

Invited Seminars (in Japan)

1. “Baryon resonances in chiral dynamics –Kaonic few-body systems–”, Nara Women’s University, 18 November 2010.

Taichiro Kugo

Journal Papers

1. Taichiro Kugo and Tsutomu T. Yanagida “Coupling Supersymmetric Nonlinear Sigma Models to Supergravity,” Prog. Theor. Phys. **124** (2010), 555 – 565. arXiv:1003.5985 [hep-th], YITP-10-24.
2. Ken-Ichi Izawa, Taichiro Kugo and Tsutomu T. Yanagida
“Gravitational Supersymmetry Breaking” Prog. Theor. Phys. **125** (2011), 261 – 264. arXiv:1008.4641 [hep-ph], YITP-10-73.

Talks at International Conferences

1. “Three Family Quarks and Leptons as Nambu-Goldstone Chiral Supermultiplets,” Invited, in “Summer Institute 2010 on Particle Physics Phenomenology”, Fuji-Yoshida, Japan, Aug. 12?19, 2010.
2. “String field theories,” Invited, in “String Field Theory and Related Aspects” (SFT2010), Kyoto, Japan, Oct. 18 – 22, 2010.

Invited Seminars (in Japan)

1. “Coupling Nonlinear Sigma models to Supergravity,” Kobayashi-Maskawa Institute for the Origin of Particles and the Universe, Nagoya University, April 14, 2010 (Bonji Seminar, in Japanese).
2. “Criticality in Gauge Dynamics Revisited,” Kobayashi-Maskawa Institute for the Origin of Particles and the Universe, Nagoya University, May 13, 2010 (Bonji Seminar, in Japanese).
3. “Three Family Quarks and Leptons as Nambu-Goldstone Chiral Supermultiplets,” Maskawa Institute for Science and Culture, Kyoto Sangyo University, May 29, 2010 (in Japanese).

4. “Three Family Quarks and Leptons as Nambu-Goldstone Chiral Supermultiplets,” Institute of Physics, University of Tokyo, Komaba, June 17, 2010 (in Japanese).

Hiroshi Kunitomo

Journal Papers

1. M. Kohriki, H. Kunitomo and M. Murata, “No-ghost Teorem for Neveu-Schwarz String in 0-picture,” Progress of Theoretical Physics **124** (2010) 953-968. arXiv:1009.0107 [hep-th], YITP-10-75.

Takao Morinari

Journal Papers

1. T. Morinari, E. Kaneshita and T. Tohyama, “Topological and Transport Properties of Dirac Fermions in Antiferromagnetic Metallic Phase of Iron-Based Superconductors,”
Phys. Rev. Lett. **105**, 037203 (4 pages) (2010).
2. T. Morinari and T. Tohyama,
“Theory of inplane magnetoresistance in two-dimensional massless Dirac fermion system,”
Phys. Rev. B **82**, 165117 (5 pages) (2010).
3. T. Morinari and T. Tohyama,
“Crossover from Positive to Negative Interlayer Magnetoresistance in Multilayer Massless Dirac Fermion System with Non-Vertical Interlayer Tunneling,”
J. Phys. Soc. Jpn. **79**, 044708 (6 pages) (2010).

Books and Proceedings

1. T. Morinari, E. Kaneshita and T. Tohyama, “Fermi surface topology effect on interlayer magnetoresistance with in-plane magnetic field in layered multiband system: Application to FeAs-based superconductors,”
Physica C **470**, 95-97 (2010).
2. T. Morinari,
“Dirac fermions in α-(BEDT-TTF)$_2$I$_3$: Some topological properties,”
Physica B **405**, S192-S194 (2010).
3. T. Himura, T. Morinari and T. Tohyama,
“Pressure dependence of interlayer magnetoresistance in α-(BEDT-TTF)$_2$I$_3$,”
Physica B **405**, S157-S159 (2010).

Talks at International Conferences

1. “Magnetoresistance in organic Dirac fermion system” Invited,
in “Workshop on Dirac Electron Systems 2011,” National Institute for Materials Science, Tsukuba, Japan,
January 19, 2011.

Masatoshi MURASE

Talks at international Conferences

1. “Life as compatible contradiction - Towards integrated studies of complex living systems” Invited talk, in 2010 International and Interdisciplinary Workshop on “Novel Phenomena in Integrated Complex Sciences: from Non-living to Living Systems” at Kyoto October, 11-14, 2010.
2. “A New Synthesis: Are Health and Disease Compatible?” Invited talk, 4th International TRI Tinnitus Conference at Dallas U.S.A., June 8-11, 2010.

Invited Seminars (in Japan)

1. Living organisms: Evolution, development and diseases (Series Lecture), September 2010, Department of Physics, Ritsumeikan University

Masatoshi MURASE

Talks at international Conferences

1. “Life as compatible contradiction - Towards integrated studies of complex living systems” Invited talk, in 2010 International and Interdisciplinary Workshop on “Novel Phenomena in Integrated Complex Sciences: from Non-living to Living Systems” at Kyoto October, 11-14, 2010.
2. “A New Synthesis: Are Health and Disease Compatible?” Invited talk, 4th International TRI Tinnitus Conference at Dallas U.S.A., June 8-11, 2010.

Invited Seminars (in Japan)

1. Living organisms: Evolution, development and diseases (Series Lecture), September 2010, Department of Physics, Ritsumeikan University

Shigehiro Nagataki

Journal Papers

1. S. Masada, S. Nagataki, K. Shibata and T. Terasawa,
"Solar-Type Magnetic Reconnection Model for Magnetar Giant Flares"
PASJ **62** (2010) 1093 (10 pages)
2. A. Calvez, A. Kusenko and S. Nagataki,
"Role of Galactic Sources and Magnetic Fields in Forming the Observed Energy-Dependent Composition of Ultrahigh-Energy Cosmic Rays"
Phys. Rev. Lett. **105** (2010) 091101 (4 pages), arXiv:1004.2535
3. J. Aoi, K. Murase, K. Takahashi, K. Ioka and S. Nagataki,
"Can We Probe the Lorentz Factor of Gamma-ray Bursts from GeV-TeV Spectra Integrated Over Internal Shocks?"
The Astrophys. J. **722** (2010) 440 (12 pages), arXiv:0904.4878
4. D. Prokhorov, Y. Dubois and S. Nagataki,
"An analysis of the temperature structure of galaxy clusters by means of the thermal Sunyaev-Zel'dovich effect"
Astron. Astrophys. **524** (2010) A89 (6 pages)

N. Kawai and S. Nagataki,
"DECIPHERING THE ANCIENT UNIVERSE WITH GAMMA-RAY BURSTS"
AIP Conference Proceedings, Volume 1279 (2010) S. Nagataki,
"GRB-SN Connection: Central Engine of Long GRBs and Explosive Nucleosynthesis"
AIP Conference Proceedings, Volume 1279, pp. 77-80 (2010) *Talks at International Conferences*

1. "Nonlinear Relativistic Jet Formation and Gamma-Ray bursts", Invited,
in "Frontiers of Nonlinear Physics physics IV", Nizhny Novgorod, Russia,
July 13-20 (2010)
2. "Gamma-Ray Burst Physics," Invited,
in "APCTP-Topical-Research-Program-2010 on From Quarks to the Cosmos: Forefront Problems at the Intersection of Astrophysics, Cosmology, Nuclear Physics and Particle Physics," Seoul, Korea,
August 17-19 (2010)
3. "Gamma-Ray Burst Physics," Invited,
in "XIV Mexican School on Particles and Fields," Morelia, Mexico,
November 4-12 (2010)
4. "Ultra-High Energy Cosmic Rays and Neutrinos," Invited, Plenary
in "XIV Mexican School on Particles and Fields," Morelia, Mexico,
November 4-12 (2010)

Invited Seminars (Overseas)

1. "Numerical High-Energy Astrophysics,"
Purdue University, USA, September 21st (2010)
2. "Development of a General Relativistic MHD Code and its Application to Modeling Gamma-Ray Bursts,"
Florida State University, Florida, USA, September 29th (2010).
3. "Numerical High-Energy Astrophysics,"
Florida State University, Florida, USA, October 1st (2010)

Akira OHNISHI

Journal Papers

1. T. Z. Nakano, K. Miura and A. Ohnishi, "Effective Potential in the Strong-coupling Lattice QCD with Next-to-Next-to-Leading Order Effects", Prog. Theor. Phys. **123** (2010), pp 825-851, YITP-09-83, arXiv:0911.3453 [hep-lat].
2. K. Tsubakihara, H. Maekawa, H. Matsumiya and A. Ohnishi, "Lambda hypernuclei and neutron star matter in a chiral SU(3) relativistic mean field model with a logarithmic potential", Phys. Rev. C **81** (2010), 065206 (13 pages), YITP-09-80, arXiv:0909.5058 [nucl-th].
3. T. Kunihiro, B. Müller, A. Ohnishi, A. Schäfer, T. T. Takahash and A. Yamamoto, "Chaotic behavior in classical Yang-Mills dynamics", Phys. Rev. D **82** (2010), 114015 (9 pages), YITP-10-77, arXiv:1008.1156 [hep-ph].
4. Takashi Z. Nakano, Kohtaroh Miura and Akira Ohnishi, "Chiral and deconfinement

transitions in strong coupling lattice QCD with finite coupling and Polyakov loop effects", Phys. Rev. D **83** (2011), 016014 (13 pages), YITP-10-78, arXiv:1009.1518 [hep-lat].

5. H. Matsumiya, K. Tsubakihara, M. Kimura, A. Dote and A. Ohnishi, "Level structure and production cross section of ${}^{12}_{\Xi}$Be studied with coupled-channels antisymmetrized molecular dynamics", Phys. Rev. C **83** (2011), 024312 (8 pages).

Books and Proceedings

1. K. Sumiyoshi, K. Nakazato, C. Ishizuka, A. Ohnishi, S. Yamada, H. Suzuki, "Emergence of hyperons in failed supernovae with short neutrino bursts", Nucl. Phys. A **835** (2010), pp 295-302, YITP-10-53.
2. H. Matsumiya, K. Tsubakihara, M. Isaka, M. Kimura, A. Doté and A. Ohnishi, "Spin-dependence of Ξ-N interaction and hypernuclear production spectrum", Nucl. Phys. A **835** (2010), pp 366-369, YITP-10-52.
3. A. Ohnishi, K. Tsubakihara, K. Sumiyoshi, C. Ishizuka, S. Yamada, H. Suzuki, "EOS of hyperonic matter for core-collapse supernovae", Nucl. Phys. A **835** (2010), pp 374-377, YITP-10-54.
4. Kohtaroh Miura, Takashi Z. Nakano, Akira Ohnishi, Noboru Kawamoto, "Chiral and deconfinement transitions in strong coupling lattice QCD", PoS **LATTICE 2010** (2010), 202 (7 pages), YITP-10-115, arXiv:1012.1509 [hep-lat].
5. Takashi Z. Nakano, Kohtaroh Miura, Akira Ohnishi, "Effective Potential and Phase Diagram in the Strong-Coupling Lattice QCD with Next-to-Next-to-Leading Order and Polyakov Loop Effects", PoS **LATTICE 2010** (2010), 205 (7 pages), YITP-10-114, arXiv:1010.5687 [hep-lat].
6. Akira Ohnishi, Kohtaroh Miura, Takashi Z. Nakano, "Another mean field treatment in the strong coupling limit of lattice QCD", PoS **LATTICE 2010** (2010), 208 (7 pages), YITP-11-43, arXiv:1104.1029 [hep-lat].

Talks at International Conferences

1. "Lambda-Lambda correlation in (K^-, K^+) reaction and heavy-ion collisions", in "Exotics from Heavy-Ion Collisions", May 17-30, 2010, Kyoto, Japan.
2. "Another Mean Field Treatment in the Strong Coupling Limit of Lattice QCD", in "The XXVIII International Symposium on Lattice Field Theory (Lattice 2010)",June 14-19, 2010, Villasimius, Sardinia, Italy.
3. "Exotics from heavy ion collisions ", in "International conference on the structure of baryons (BARYONS'10)", Dec. 7-11, 2010, Osaka, Japan.
4. "Hadronic Transport: JAM", Invited, in "Workshop on Excited Hadronic States and the Deconfinement Transition", J-Lab, USA, Feb. 23-25, 2011.

Invited Seminars (in Japan)

1. "Nuclear Matter Equation of State and Hyperons", RIBF monthly colloquium, July 20, 2010, RIKEN, Japan (in Japanese).
2. "Nuclear Matter Equation of State and QCD Phase Diagram", GCOE seminar, July 30, 2010, Tohoku University, Sendai, Japan.
3. Lecture series on "Lattice QCD at strong coupling and the phase diagram of quark matter", Dec. 20-22, 2010, Tohoku University, Sendai, Japan (in Japanese).

Misao Sasaki

Journal Papers

1. J. -O. Gong and M. Sasaki, JCAP **1103**, 028 (2011) [arXiv:1010.3405 [astro-ph.CO]].
2. C. -M. Yoo, K. -i. Nakao and M. Sasaki, JCAP **1010**, 011 (2010) [arXiv:1008.0469 [astro-ph.CO]].
3. D. Yamauchi, K. Takahashi, Y. Sendouda, C. -M. Yoo and M. Sasaki, Phys. Rev. D **82**, 063518 (2010) [arXiv:1006.0687 [astro-ph.CO]].
4. J. Fonseca, M. Sasaki and D. Wands, JCAP **1009**, 012 (2010) [arXiv:1005.4053 [astro-ph.CO]].
5. M. Ando, S. Kawamura, N. Seto, S. Sato, T. Nakamura, K. Tsubono, T. Takashima and I. Funaki *et al.*, Class. Quant. Grav. **27**, 084010 (2010).
6. C. -M. Yoo, K. -i. Nakao and M. Sasaki, JCAP **1007**, 012 (2010) [arXiv:1005.0048 [astro-ph.CO]].
7. Y. -i. Takamizu, S. Mukohyama, M. Sasaki and Y. Tanaka, JCAP **1006**, 019 (2010) [arXiv:1004.1870 [astro-ph.CO]].

8. D. Yamauchi, Y. Sendouda, C. -M. Yoo, K. Takahashi, A. Naruko and M. Sasaki, JCAP **1005**, 033 (2010) [arXiv:1004.0600 [astro-ph.CO]].
9. F. Arroja and M. Sasaki, Phys. Rev. D **81**, 107301 (2010) [arXiv:1002.1376 [astro-ph.CO]].
10. J. -O. Gong, S. Koh and M. Sasaki, Phys. Rev. D **81**, 084053 (2010) [arXiv:1002.1429 [hep-th]].
11. I. Zaballa and M. Sasaki, JCAP **1003**, 002 (2010) [arXiv:0911.2069 [astro-ph.CO]].
12. T. Clunan and M. Sasaki, Class. Quant. Grav. **27**, 165014 (2010) [arXiv:0907.3868 [hep-th]].

Talks at International Conferences

1. "Physical equivalence among different conformal frames," Invited, IEU-APCTP Workshop "Cosmology and Fundamental Physics," IEU, Ewha Womans University, Seoul, 17–19 May, 2010.
2. "Black hole perturbations I, II," Invited Lectures, 2010 International School on "Numerical Relativity and Gravitational Waves," APCTP, Pohang, 26–30 July, 2010.
3. "Lectures on Inflationary Cosmology I, II," Invited Lectures, Summer Institute 2010 "Cosmology and String," Fuji-Yoshida, 4–14 August, 2010.
4. "Summary," Invited, The 20th workshop on General Relativity and Gravitation in Japan (JGRG20), YITP, 21–25 September, 2010.
5. "Observational equivalence of conformally equivalent spacetimes," Invited lectures, Workshop on "Gravity, Geometry, Particles," Osaka City University, 27–29 September, 2010.
6. "Inflation and Cosmological Perturbation Theory I,II,III,IV," Invited Lectures, 5th Asian Winter School on Strings, Particles and Cosmology, Jeju, Korea, 10–17 January, 2011.

Invited Seminars (Overseas)

1. "Observational equivalence of conformally related frames," University of Durham, UK, 30 April, 2010.
2. "Conformal invariance of classical gravity," Trento University, Italy, 9 August, 2010.
3. "Conformal invariance of classical gravity," ICG, University of Portsmouth, UK, 1 December, 2010.
4. "Conformal-frame (In)dependence in Cosmology," KIAS, Korea, 9 February, 2011.

Ryu SASAKI

Journal Papers

1. C-L. Ho, S. Odake and R. Sasaki, "Properties of the exceptional (X_ℓ) Laguerre and Jacobi polynomials," SIGMA **7** (2011) 107 (24 pp) YITP-09-70, `arXiv:0912.5477[math-ph]`.
2. Leonor García-Gutiérrez, S. Odake and R. Sasaki, "Modification of Crum's Theorem for 'Discrete' Quantum Mechanics," Prog. Theor. Phys. **124** (2010) 1-24, YITP-10-15, `arXiv:1004.0289[math-ph]`.
3. S. Odake and R. Sasaki, "Exceptional Askey-Wilson type polynomials through Darboux-Crum transformations," J. Phys. A **43** (2010) 335201 (18pp), YITP-10-19, `arXiv:1004.0544[math-ph]`.
4. R. Sasaki, S. Tsujimoto and A. Zhedanov, "Exceptional Laguerre and Jacobi polynomials and the corresponding potentials through Darboux-Crum transformations," J. Phys. A **43** (2010) 315204 (20pp), YITP-10-17, `arXiv:1004.4711[math-ph]`.
5. R. Sasaki, "Exactly and Quasi-Exactly Solvable 'Discrete' Quantum Mechanics," Phil. Trans. R. Soc. **A369** (2011) 1301-1318, doi: 10.1098/rsta.2010.0262 YITP-10-33, `arXiv:1004.4712[math-ph]`.
6. S. Odake and R. Sasaki, "A new family of shape invariantly deformed Darboux-Pöschl-Teller potentials with continuous ℓ," J. Phys. A **44** (2011) 195203 (14pp) YITP-10-64, `arXiv:1007.3800[math-ph]`.
7. S. Odake and R. Sasaki, "Dual Christoffel transformations," Prog. Theor. Phys. **126** (2011) 1-34. YITP-11-07, `arXiv:1101.5468[math-ph]`.
8. S. Odake and R. Sasaki, "Exceptional (X_ℓ) (q)-Racah polynomials," Prog. Theor. Phys. **125** (2011) 851-870. YITP-11-18, `arXiv:1102.0812[math-ph]`.
9. S. Odake and R. Sasaki, "Discrete quantum mechanics," (Topical Review) J. Phys.

A44 (2011) 353001 (47 pp), YITP-11-35 `arXiv:1104.0473[math-ph]`.

Talks at International Conferences

1. "Exceptional orthogonal polynomials and difference Schrödinger equations,"
in "SIDE9 (Symmetry and Integrability in Difference Equations 9)," Varna, Bulgaria, June 2010.
2. "Exactly Solvable (Discrete) Quantum Mechanics and Exceptional Orthogonal Polynomials," Invited,
in "The Second International Conference: Nonlinear Waves–Theory and Applications," Tsinghwa University, Beijing, China, June 2010.

Invited Seminars (Overseas)

1. "Exceptional Orthogonal Polynomials,"
Taipei String Seminar, National Taiwan University, Taipei, Taiwan, November 2010.
2. "Exactly Solvable Quantum Mechanics and Exceptional Orthogonal Polynomials,"
One Day Colloquium, Saha Institute for Nuclear Research, Kolkata, India, December 2010.
3. "Discrete Quantum Mechanics and Exceptional Orthogonal Polynomials,"
Physics & Applied Mathematics Unit, Indian Institute of Statistics Kolkata, December 2010
4. "Exactly Solvable Quantum Mechanics and Exceptional Orthogonal Polynomials,"
Institute of Physics, Bhubaneswar, December 2010.
5. "Exceptional Orthogonal Polynomials: Global solutions of a second order Fuchsian equation with 3+ℓ regular singularities," Department of Physics, University of Rome, La Sapienza, Rome, Italy, February 2011.
6. "Exceptional orthogonal polynomials in Quantum Mechanics: Global solutions of a second order Fuchsian equation with 3+ℓ regular singularities," SISSA, Trieste, Italy February 2011.

Invited Seminars (in Japan)

1. "Exceptional Orthogonal Polynomials: Global solutions of a second order Fuchsian equation with 3+ℓ regular singularities," (in Japanese)
Colloquium at Graduate School of Mathematical Sciences, University of Tokyo, Komaba, Tokyo, October 2010.
2. "Exactly Solvable Discrete Quantum Mechanics,"
"Lie Groups and their Surroundings," held at Dept. Math. Shinshu University Matsumoto, October 2010.
3. "Exceptional Orthogonal Polynomials: Global solutions of a second order Fuchsian equation with 3+ℓ regular singularities," (in Japanese)
Department of Mathematics, Kumamoto University, Kumamoto October 2010.
4. "Exceptional Orthogonal Polynomials: Global solutions of a second order Fuchsian equation with 3+ℓ regular singularities," (in Japanese)
Numadzu Workshop, Numazu National College of Technology Numazu, March 2011.

Naoki Sasakura

Journal Papers

1. N. Sasakura,
"A Renormalization procedure for tensor models and scalar-tensor theories of gravity," Int. J. Mod. Phys. A **25**, 4475 (2010) [arXiv:1005.3088 [hep-th]], YITP-10-37.

Talks at International Conferences

1. "Emergent scalar-tensor theories of gravity from tensor models," Invited, in "QGC2010 NIMS-APCTP Joint International Workshop on String Theory and Cosmology," Hotelspapia, Daejeon, Korea, September 30 - October 2, 2010.

Invited Seminars (Overseas)

1. "Emergent space and general relativity from tensor models, and possibility of emergent gauge fields and fermions," Vienna University, Austria, November 16, 2010.

Invited Seminars (in Japan)

1. "Emergence of scalar-tensor theory of gravity and further possibilities," Rikkyo University, January 5, 2011 (in Japanese, in

Workshop on Field Theory and Quantum Gravity).
2. "Quantum gravity and fuzzy spaces," Shiga Heights Administration Building of Ochanomizu University, March 11, 2011 (in Japanese, lectures in Shinshu Winter School).

Masaru SHIBATA

Journal Papers

1. K. Kiuchi, Y. Sekiguchi, M. Shibata, and K. Taniguchi,
"Exploring binary-neutron-star-merger scenario of short-gamma-ray bursts by gravitational-wave observation,"
Phys. Rev. Lett. **104** (2010) 141101 (4 pages).
2. K. Taniguchi, M. Shibata,
"Binary neutron stars in quasiequilibrium,"
Astrophys. J. Supple. **188** (2010) 187–208.
3. M. Shibata and H. Yoshino,
"Bar-mode instability of rapidly spinning black hole in higher dimensions,"
Phys. Rev. D **81** (2010) 104035 (20 pages).
4. P. Montero, J.A. Font, and M. Shibata,
"Influence of self-gravity on the runaway instability of black hole-torus systems,"
Phys. Rev. Lett. **104** (2010) 191101 (4 pages).
5. K. Kyutoku, M. Shibata, and K. Taniguchi,
"Gravitational waves from nonspinning black hole-neutron star binaries: dependence on equations of state,"
Phys. Rev. D **82** (2010) 044049 (24 pages).
6. L. Baiotti, M. Shibata, and T. Yamamoto,
"Binary neutron-star mergers with Whisky and SACRA: First quantitative comparison of results from independent general-relativistic hydrodynamics codes,"
Phys. Rev. D **82** (2010) 064015 (15 pages).
7. M. Shibata and K. Kyutoku,
"Constraining Nuclear-Matter Equations of State by Gravitational waves from Black hole-Neutron star Binaries,"
Prog. Theor. Phys. Supple. **186** (2010) 17–25.

Talks at International Conferences

1. "Higher-dimensional numerical relativity" Invited, in "YKIS", Kyoto, June 28–July 2, 2011.
2. "Merger of binary neutron stars and black hole neutron star binaries" Invited,
in "Asia-Pacific School and Workshop on Gravitation",
Shanghai, China, 10–14 February, 2011.

Invited Seminars (Overseas)

1. "Merger of black hole and neutron star," Department of Physics, University of Milwaukee at Wisconsin, USA, 2 October 2010.

Invited Seminars (in Japan)

1. "Numerical Relativity,"
Lecture series on Computational Physics, The University of Tokyo, 9-10 June 2010.

Ken-ichi Shizuya

Journal Papers

1. K. Shizuya, "Renormalization and cyclotron resonance in bilayer graphene with weak electron-hole asymmetry," Phys. Rev. **B 84** (2011) 075409 1-10, arXiv:1103.5696, YITP-11-38.

Books and Proceedings

1. K. Shizuya, "Renormalization and quantum breaking of scale invariance - Weyl anomaly" (in Japanese), Mathematical Science No. 570 (2010) 34 - 39.

Fumihiro Takayama

Invited Seminars (in Japan)

1. "At the New Era of Microscopes and Telescopes: Dark Matter and Beyond the Particle Standard Model,"
YITP, Kyoto Univ., May 2010 (YITP colloquium).
2. "SuperWeakly Interacting Massive Particles as Present Dark Matter,"
Maskawa Inst., Kyoto-Sangyo Univ., June 2010 (in Japanese).
3. "SuperWIMP,"
Dept. of Phys., Osaka Univ., June 2010 (in Japanese).

4. "Long-Lived Massive Particles and Dark Matter Physics in the Early Universe,"
Dept. of Phys., Nagoya Univ., November 2010 .
5. "Long-Lived Massive Particles and Dark Matter Physics in the Early Universe,"
Dept. of Phys., Tohoku Univ., December 2010 .

Takahiro Tanaka

Journal Papers

1. T. Tanaka, T. Suyama and S. Yokoyama,
"Use of delta N formalism - Difficulties in generating large local-type non-Gaussianity during inflation -,"
Class. Quant. Grav. **27** (2010) 124003, YITP-10-32, arXiv:1003.5057.
2. A. De Felice and T. Tanaka,
"Inevitable ghost and the degrees of freedom in $f(R,G)$ gravity,"
Prog. Theor. Phys. **124** (2010) 503 (13 pages), YITP-10-49, arXiv:1006.4399.
3. Y. Urakawa and T. Tanaka,
"IR divergence does not affect the gauge-invariant curvature perturbation,"
Phys. Rev. D **82** (2010) 121301 (5 pages), YITP-10-56, arXiv:1007.0468.
4. Y. Urakawa and T. Tanaka,
"Natural selection of inflationary vacuum required by infra-red regularity and gauge-invariance,"
Prog. Theor. Phys. **125** (2011) 1067 (23 pages), YITP-10-81, arXiv:1009.2947.
5. A. Flachi and T. Tanaka,
"Chiral Modulations in Curved Space I: Formalism,"
JHEP **1102** (2011) 026 (22 pages), YITP-10-102, arXiv:1012.0463.
6. J. O. Gong and T. Tanaka,
"A covariant approach to general field space metric in multi-field inflation,"
JCAP **1103** (2011) 015 (xx pages), YITP-11-9, arXiv:1101.4809.

Talks at International Conferences

1. "IR issues in the inflationary universe" Invited,
in "Extra-Dimension Probe by Cosmophysics," KEK, Tsukuba, Japan,
Nov. 2010.
2. "Gravitational Radiation Reaction" Invited, in "Shanghai Asia-Pacific School and Workshop on Gravitation," Shanghai, China,
Feb. 2011.

Invited Seminars (in Japan)

1. "Brane Gravity,"
Summer school of astronomy and astrophysics, Nagoya, August 2010 (in Japanese).
2. " IR divergence and initial vacuum state,"
Annual meeting of physical society of Japan, Kyushu univ. of tech., September 2010 (in Japanese).

Seiji Terashima

Journal Papers

1. T. Azeyanagi, N.Ogawa and S. Terashima,
"Emergent AdS_3 in the Zero Entropy Extremal Black Holes,"
JHEP **1103** (2011) 004, arXiv:1010.4291 [hep-th].
2. S. Terashima and F. Yagi,
"On Effective Action of Multiple M5-branes and ABJM Action,"
JHEP **1103** (2011) 036, arXiv:1012.3961 [hep-th].

Talks at International Conferences
Invited Seminars (Overseas)

1. "Multiple M5-branes and ABJM Theory,"
National Taiwan University, Taiwan, Feburary 2011.

Invited Seminars (in Japan)

1. "M5-branes and ABJM action,"
RIKEN, September.

Takami TOHYAMA

Journal Papers

1. T. Morinari and T. Tohyama,
"Crossover from Positive to Negative Interlayer Magnetoresistance in Multilayer Massless Dirac Fermion System with Non-Vertical Interlayer Tunneling,"
J. Phys. Soc. Jpn. **79** (2010) 044708 (6 pages), arXiv:0912.0566 [cond-mat].

2. T. Morinari, E. Kaneshita and T. Tohyama, "Topological and Transport Properties of Dirac Fermions in an Antiferromagnetic Metallic Phase of Iron-Based Superconductors," Phys. Rev. Lett. **105** (2010) 037203 (4 pages), arXiv:1003.5469 [cond-mat].
3. T. Sugimoto, S. Sota and T. Tohyama, "Chirality in spin- 1/2 zigzag XY chain: Low-temperature density-matrix renormalization group study," Phys. Rev. B **82** (2010) 035437 (6 pages), arXiv:1003.5469 [cond-mat].
4. W. B. Gao, J. Linden, X. C. Wang, C. Q. Jin, T. Tohyama, M. Karppinen and H. Yamauchi, "Evolution of the hyperfine parameters of Fe in superconducting LiFeAs as observed by 57Fe Mossbauer spectroscopy," Solid State Commun. **150** (2010) 1525-1528.
5. W. Chen, O. P. Sushkov and T. Tohyama, "Magnetic quantum oscillations and multiple holon pockets in underdoped $YBa_2Cu_3O_{6+y}$," Phys. Rev. B **82** (2010) 060511(R) (4 pages), arXiv:1001.1025 [cond-mat].
6. E. Kaneshita and T. Tohyama, "Spin and charge dynamics ruled by antiferromagnetic order in iron pnictide superconductors," Phys. Rev. B **82** (2010) 094441 (5 pages), arXiv:1002.2701 [cond-mat].
7. T. Morinari and T. Tohyama, "Theory of inplane magnetoresistance in two-dimensional massless Dirac fermion system," Phys. Rev. B **82** (2010) 165117 (5 pages), arXiv:1006.0567 [cond-mat].
8. S. Sota and T. Tohyama, "Density matrix renormalization group study of optical conductivity in the one-dimensional Mott insulator Sr_2CuO_3," Phys. Rev. B **82** (2010) 195130 (5 pages), arXiv:1007.5166 [cond-mat].
9. G. Khaliullin, M. Mori, T. Tohyama and S. Maekawa, "Enhanced Pairing Correlations near Oxygen Dopants in Cuprate Superconductors," Phys. Rev. Lett. **105** (2010) 257005 (4 pages), arXiv:1008.0435 [cond-mat].
10. T. Himura, T. Morinari and T. Tohyama, "Pressure dependence of interlayer magnetoresistance in α-(BEDT-TTF)$_2I_3$," Physica B **405** (2010) S157-S159.
11. M. Yoshida, K. Ishii, K. Ikeuchi, I. Jarrige, Y. Murakami, J. Mizuki, K. Tsutsui, T. Tohyama, S. Maekawa, K. Kudo, Y. Koike and Y. Endoh, "Temperature dependence of the electronic structure of $Sr_{14}Cu_{24}O_{41}$ studied by resonant inelastic X-ray scattering," Physica C **470** (2010) S145-S146.
12. K. Ishii, K. Ikeuchi, I. Jarrige, J. Mizuki, H. Hiraka, K. Yamada, K. Tsutsui, T. Tohyama, S. Maekawa, Y. Endoh, H. Ishii and Y. Q. Cai, "Resonant inelastic X-ray scattering of $La_2Cu_{0.95}Ni_{0.05}O_4$," Physica C **470** (2010) S155-S157.
13. K. Tsutsui, T. Tohyama and S. Maekawa, "Theoretical study of resonant inelastic X-ray scattering spectrum in the Hubbard ladder," Physica C **470** (2010) S232-S233.
14. E. Kaneshita, T. Tohyama and A. R. Bishop, "Modeling of pressure effects in striped nickelates," Physica C **470** (2010) S247-S248.
15. H. Yoshizumi, T. Tohyama and T. Morinari, "Induced order in nonequivalent two-layer system," Physica C **470** (2010) S921-S922.
16. S. Sota and T. Tohyama, "Low-temperature density matrix renormalization group study on spin-1/2 frustrated spin chains," J. Phys.: Conf. Ser. **200** (2010) 012191 (4 pages).
17. K. Sugimoto, E. Kaneshita and T. Tohyama, "Origin of In-Plane Anisotropy in Optical Conductivity for Antiferromagnetic Metallic Phase of Iron Pnictides," J. Phys. Soc. Jpn. **80** (2011) 033706(L) (4 pages), arXiv:1012.0670 [cond-mat].

Talks at International Conferences

1. "Electronic and Magnetic Properties in the Antiferromagnetic Metallic Phase of Iron Pnictide Superconductors,"

in "International Conference on Quantum Phenomena in Complex Matter (Superstripes2010)," Erice, Itary,
July 2010.
2. "Low-temperature density matrix renormalization group study of spin-1/2 zigzag XY chain,"
in "International Workshop on Statistical Physics of Quantum Systems," Tokyo, Japan,
August 2010.
3. "Cuprates and Iron Pnictides: "Mott" physics vs. "Slater" physics," Invited,
in "A3 Foresight Program of "Joint Research on Novel Properties of Complex Oxides"," Kyoto, Japan,
November 2010.
4. "Electronic and Magnetic Properties in the Antiferromagnetic Metallic Phase of Iron Pnictide Superconductors," Invited,
in "The 9th Asia Pacific Workshop on Material Physics," Hanoi, Betonam,
December 2010.
5. "Electronic and Magnetic Properties in the Antiferromagnetic Metallic Phase of Iron Pnictide Superconductors," Invited,
in "11th Korea-Japan-Taiwan Symposium on Strongly Correlated Electron System," Jeju, Korea,
February 2011.
6. "Electronic and Magnetic Excitations in the Antiferromagnetic Metallic Phase of Iron Pnictide Superconductors,"
in "International Workshop on Novel Superconductors and Super Materials 2011," Tokyo, Japan,
March 2011.

Talks at domenstic Conferences

1. "Theory: Comments from the viewpoints of condensed matter physics," Invited,
in "Symposium of JPS meeting," Osaka,
September 2010.
2. " Electronic state and magnetism of Fe_2S_2 clusters,"
in "JPS meeting," Osaka,
September 2010.

Invited Seminars (Overseas)

1. "Electronic and Magnetic Properties in the Antiferromagnetic Metallic Phase of Iron Pnictide Superconductors,"
Josph Stephan Institute, Ljubliana, Slovania, May 2010.
2. "Low-Temperature DMRG Study of Spin-1/2 Zigzag XY Chain,"
Hannover University, Hannover, Germany, July 2010.
3. "Electronic and Magnetic Properties in the Antiferromagnetic Metallic Phase of Iron Pnictide Superconductors,"
Ames Laboratory, Iowa, USA, August 2010.
4. "Dynamical DMRG study of one-dimensional strongly correlated systems,"
LPTMS, Paris-South University, Paris, France, February 2011.

Invited Seminars (in Japan)

1. "Electronic and Magnetic Properties in the Antiferromagnetic Metallic Phase of Iron Pnictide Superconductors,"
ASRC, JAEA, April 2010 (in Japanese).

Keisuke TOTSUKA

Journal Papers

1. Hiroaki T Ueda, Keisuke Totsuka, and Tsutomu Momoi,
"Dilute-bose-gas approach to ground state phases of 3D quantum helimagnets under high magnetic field"
J. Phys.: Conf. Ser., **200** (2010) 022067 (4 pages).
2. K. Nakata and K. Totsuka
"Extended quantum dimer model and novel valence-bond phases"
J.Stat.Mech. conf. series, (2011) P01033 (20 pages).
3. J. Romhányi, K. Totsuka, and K. Penc,
"Effect of Dzyaloshinskii-Moriya interactions on the phase diagram and magnetic excitations of $SrCu_2(BO_3)_2$"
Phys.Rev. B, **83** (2011) 024413 (18 pages).

Talks at International Conferences

1. "Possible featureless spin liquids at magnetization plateaus" (invited),
in "Unconventional magnetism in High Fields" (Advanced Study Group 2010), Max-Planck Institute for Physics of Complex Systems, Dresden, Germany
4 June 2010.

2. "A unifying approach to unconventional orders in frustrated spin systems" (invited), in "International Conference on Frustrated Spin Systems, Cold Atoms and Nanomaterials" (Satellite of STATPHYS24), Hanoi, Vietnam
July 14–16, 2010.
3. "Hidden order and dynamics of SUSY VBS models", in "New Development of Numerical Simulations in Low-Dimensional Quantum Systems", Kyoto, Japan
October 27-29, 2010.

Talks at Other Conferences and Workshops

1. "Contractor Renormalization Study of 1D- and 2D Spin Systems with Ring-Exchange Interactions", in Autumn Meeting of the Physical Society of Japan', Osaka Prefectural University, Japan
25 September 2010.
2. "Bond-operator approach to phase diagram and low-lying excitations of Shastry-Sutherland model", in Autumn Meeting of the Physical Society of Japan', Osaka Prefectural University, Japan
24 September 2010.

Invited Seminars (Overseas)

1. "Possible featureless spin liquid states in high magnetic field – Magnetization plateaus revisited", Paul-Sabatier University, Toulouse, France,
22 June 2010.
2. "Geometric Approach to Magnetization Plateaus", IPhT CEA Saclay, France,
7 December 2010.
3. "Geometric Approach to Magnetization Plateaus – " quantization condition " revisited and possible spin liquids at high magnetic fields", École Polytechnique Fédéral de Lausanne (EPFL), Switzerland,
16 December 2010.

Hirofumi Wada

Journal Papers

1. Takahiro Sakaue, Guillaume Witz, Giovanni Dielter, and Hirofumi Wada, "Universal bond correlation function for two-dimensional polymer rings," Europhys. Lett. **91** (2010) 68002 (6 pages).

Talks at International Conferences

1. "Topological flow in twisted open polymers: Plectoneme, belt-trick, and rotatio nal friction," Invited, in International workshop: "Statistical Physics and Topology of Polymers with Ramifications to Structure and Function of DNA and Proteins", Yukawa Institute for Theoretical Physics, Kyoto University, Kyoto Japan
August 2010.
2. "Low Reynolds number swimming in viscoelastic fluids," Invited, in "Mechano-Biology" symposium in "4th Shanghai International Conference on Biophysics and Molecular Biology", Shanghai, China
August 2010.

Invited Seminars (Overseas)

1. "Motion and transport in a viscous fluid,": 4 weeks course lectures at EPFL, Lausanne, Switzerland, May 2010.

2.3.3 Publications and Talks by Research Fellows and Graduate Students (April 2010– March 2011)

Takenori Furumoto

Journal Papers

1. K. Horii, M. Takashina, T. Furumoto, Y. Sakuragi, and H. Toki,
"Elastic scattering of ^{8}B from ^{12}C with internal three-cluster structure of ^{8}B,"
Phys. Rev. **C81** (2010) 061602(R) (5 pages), YITP-10-60.
2. T. Furumoto, Y. Sakuragi, and Y. Yamamoto,
"Repulsive nature of optical potentials for high-energy heavy-ion scattering,"
Phys. Rev. **C82** (2010) 044612 (14 pages), YITP-10-92, arXiv:1010.1661 [nucl-th].

Talks at International Conferences

1. "Role of Three-Body Forces in Proton and Heavy-Ion scatterings,"
in "International Nuclear Physics Conference 2010," University of British Columbia, Vancouver, Canada,
July 2010.

Maiko KOHRIKI

Journal Papers

1. M. Kohriki, H. Kunitomo and M. Murata,
"No-ghost Theorem for Neveu-Schwarz string in 0-picture,"
Prog. Theor. Phys. **124** (2010) 953 YITP-10-75, [arXiv:1009.0107 [hep-th]].

Books and Proceedings

1. M. Kohriki, H. Kunitomo and M. Murata,
"No-ghost theorem for Neveu-Schwarz string in 0-picture via similarity transformation,"
Prog. Theor. Phys. Suppl. **188** (2011) 254.
Proceedings of the International Conference "String Field Theory and Related Aspects (SFT2010)"

Talks at International Conferences

1. "No-ghost Theorem for Neveu-Schwarz string in 0-picture,"
in "String Field Theory and Related Aspects (SFT2010),h workshop at Yukawa Institute for Theoretical Physics, Japan,
19–22 October 2010.

Invited Seminars (in Japan)

1. "No-ghost Theorem for Neveu-Schwarz string in 0-picture,"
Dept. Physics, Nara Women's Univ., 19 November 2010.

Masashi Kimura

Journal Papers

1. Tomohiro Harada and Masashi Kimura
"Collision of an object in the transition from adiabatic inspiral to plunge around a Kerr black hole,"
Phys. Rev. **D84** (2011) 124032 (8 pages), YITP-11-75, arXiv:1109.6722 [gr-qc].
2. Takamitsu Tatsuoka, Hideki Ishihara, Masashi Kimura and Ken Matsuno
"Extremal Charged Black Holes with a Twisted Extra Dimension,"
accepted for publication in Phys.Rev.D, YITP-11-42, arXiv:1109.6722 [gr-qc].

Talks at International Conferences

1. "Analyticity of event horizons of extremal Kaluza-Klein black holes," Invited,
in "BIRS Workshop 11w5099 Black Holes New Horizons," Banff, Canada,
November 2011.

Koutarou Kyutoku

Journal Papers

1. M. Shibata, and K. Kyutoku,
"Constraining nuclear-matter equations of state by gravitational waves from black hole-neutron star binaries,"
Prog. Theor. Phys. Suppl. **186** (2010) 17-25 (9 pages).

2. K. Kyutoku, M. Shibata, and K. Taniguchi, "Gravitational waves from nonspinning black hole-neutron star binaries: dependence on equations of state,"
Phys. Rev. D **82** (2010) 044049 (24 pages), arXiv:1008.1460 [astro-ph].

Talks at International Conferences

1. "Gravitational waves from spinning black hole-neutron star binaries: dependence on black hole spins,"
in "Japanese Physical Society," Niigata University, March 2011.
2. "Gravitational waves from spinning black hole-neutron star binaries,"
in GCOE Symposium "Emerging frontiers of Physics," Kyoto University, Kyoto, Japan,
February 2011.
3. "Gravitational waves from black hole-neutron star binaries: dependence on equations of state,"
in "Japanese Physical Society," Kyushu Institute of Technology, September 2010.
4. "Gravitational waves from nonspinning black hole-neutron star binaries: dependence on equations of state,"
in "2010 International Schoold of on Numerical Relativity and Gravitational waves", POSTECH, Pohan, Korea,
July 2010.

Invited Seminars (Overseas)

1. "Gravitational waves from black hole-neutron star binaries: dependence on equations of state and black hole spins,"
l'Observatoire de Paris-Meudon, France, October 2010.

Norichika Sago

Journal Papers

1. L. Barack and N. Sago,
"Gravitational self-force on a particle in eccentric orbit around a Schwarzschild black hole"
Phys. Rev. **D81** (2010) 084021 (35 pages), arXiv:1002.2386 [gr-qc].
2. L. Barack, T. Damour and N. Sago,
"Precession effect of the gravitational self-force in a Schwarzschild spacetime and the effective one-body formalism"
Phys. Rev. **D82** (2010) 084036 (21 pages), arXiv:1008.0935 [gr-qc].

Talks at International Conferences

1. "Gravitational self-force effect on the periapsis advance in Schwarzschild spacetime,"
in "13th Capra Meeting on Radiation Reaction," Perimeter Institute for Theoretical Physics, Waterloo, Canada,
June 2010.

Invited Seminars (in Japan)

1. "Motion of a point mass in Schwarzschild spacetime,"
Dept. of Phys., Rikkyo Univ., November 2010 (in Japanese).

Shigetoshi Sota

Journal Papers

1. T. Sugimoto, S. Sota, and T. Tohyama,
"Chirality in spin-1/2 zigzag XY chain: Low-temperature density-matrix renormalization group study,"
Phys. Rev. B **82** (2010) 035437 (6 pages) .
2. S. Sota and T. Tohyama,
"Density matrix renormalization group study of optical conductivity in the one-dimensional Mott insulator Sr_2CuO_3,"
Phys. Rev. B **82** (2010) 195130 (5 pages) .

Yudai Suwa

Journal Papers

1. Y. Suwa and K. Ioka,
"Can Gamma-ray Burst Jets Break Out the First Stars?",
Astrophys. J. **726** (2011) 107 (7 pages), arXiv:1009.6001 [astro-ph.CO]

Talks at International Conferences

1. "First Gamma-Ray Bursts and Afterglows Imprinting Population III Progenitor Structure", Plenary,
in "Deciphering the Ancient Universe with GRBs", Kyoto, Japan,
April 2010.

2. “Gamma-Ray Bursts of First Stars”, Plenary,
in “Gamma-Ray Bursts 2010 Conference”, Annapolis, US,
November 2010.

Invited Seminars (in Japan)

1. “Explosion Mechanism of Core-Collapse Supernovae and Multidimensional Simulations”,
Dept. of Earth and Space Science, Osaka Univ., June 2010 (in Japanese).

2.4 Seminars, Colloquia and Lectures

▷ 2010.4.1 — 2011.3.31

4.7 Marvin Weinstein (SLAC) : Strange Bedfellows: Quantum Mechanics and Data Mining

4.14 Kazuya Yonekura (Graduate School of Science, The University of Tokyo): On models of low-scale gauge mediation with light gravitino

4.14 Alberto Martinez Torres (YITP, Kyoto University): GCOE/YITP Seminar: Three-body hadron resonances

4.14 Andrea Prudenziati (S.I.S.S.A./I.S.A.S.) : Taming Open/Closed string duality as a Losev trick

4.14 Kensuke Kobayashi (Institute for Chemical Research, Kyoto University) : Non-equillibrium quantum noise in semiconductor mesoscopic systems

4.15 Naoki Yoshida (IPMU) : The first stars, galaxies, and blackholes

4.20 Yifu Cai (Institute of High Energy Physics, Chinese Academy of Sciences) : GCOE/YITP Seminar: Phenomenological Aspects of Bounce Cosmology

4.21 Isao Kishimoto (YITP) : Linear gauges and BV formalism in open string field theory

4.22 Teiji Kunihiro (Kyoto University) : GCOE/YITP Seminar: RG derivation of relativistic fluiddynamic equations for a viscous fluid

4.26 Pedro Montero (Max Planck Institute for astrophysics) : Influence of self-gravity on the runaway instability of black hole-torus systems

4.26 Masaru Siino (Tokyo Institute of Technology) : The application of black hole topology to gravitational wave astronomy

4.26 Mami Iwata (Osaka University) : A theory for critical fluctuation of dynamical events

4.28 Guenter von Gehlen (Bonn Univ.) : Spin operator matrix elements of the superintegrable chiral Potts quantum chain

4.28 Shigeo Okubo (Kochi Women's University) : Bose-Einstein condensation of alpha particles and superfluidity in nuclei

5.6 Koji Uryu (University of the Ryukyus) : Thermodynamics and a formulation of magnetized binary black holes and neutron stars in equilibrium

5.10-11 Akira Shimizu (The University of Tokyo) : Lecture Series:Nonequilibrium Quantum Statistical Mechanics

5.12 Yasuyuki Hatsuda (YITP) : Thermodynamic Bethe Ansatz Equations for Minimal Surfaces in AdS_3

5.13 Wei-Tou Ni (National Tsing Hua University) : Gravitational Waves, Dark Energy and Inflation

5.14 Jocelyn Read (Albert-Einstein Institute) : Measuring tidal deformation in binary neutron star inspiral

5.18 Wolfgang Lerche (CERN) : Matrix Factorizations, Contact Terms and Homological Mirror Symmetry

5.19 Hiroaki Sugiyama (Ritsumeikan Univ.) : Constraints from Lepton Flavor Violating Processes in the Higgs Triplet Model

5.19 Yoichi Ando (ISIR, Osaka University) : Progress and Prospects of the Experimental Studies of Topological Insulators

5.19 Takeshi Kawasaki (Kyoto Univ.) : Study on the glass transition and the crystallization in the three-dimensional colloidal systems by use of Brownian dynamics simulations

5.24 Fumihiro Takayama (YITP) : YITP Colloquium: At the New Era of Microscopes and Telescopes : Dark Matter and Beyond the Particle Standard Model

5.26 Janos Balog (KFKI Research Institute) : Luscher corrections in integrable and string sigma models

6.2 Yasufumi Konishi (Maskawa Institute for Science and Culture, Kyoto Sangyo University) : Mass Matrices and Flavor Mixings in Gauge Field Theory of Horizontal Symmetry

6.2 David Rees (RIKEN) : Transport Measurements of Electrons on the Surface of Liquid

Helium at a Nano-fabricated Point Constriction

6.3 Hirotaka Ito (Tohoku Univ.) : Non-Thermal emissions from shells of AGN cocoons

6.4 Su Houng Lee (YITP/Yonsei University) : Diquarks and heavy exotics

6.9 Motomu Tsuda (Saitama Institute of Technology) : NL/L SUSY relation and low energy particle physics

6.9 Masa-aki Sakagami (Graduate School of Human and Enviromental Studies, Kyoto Univ.) : Dynamics of Fish School: Numerical simulation and movie analysis

6.10 Udit Raha (National Taiwan University) : Space- and Time-like Electromagnetic Pion and Kaon Form Factors in Light-cone pQCD

6.11 Dario Vretenar (Physics Department, University of Zagreb) : Nuclear Energy Density Functionals

6.14 Jason D. Holt (University of Tennessee) : A Frontier in Nuclear Structure : Three-Nucleon Forces in Medium-Mass, Neutron-Rich Nuclei

6.14 Ewan Stewart (YITP/KAIST) : YITP Colloquium: Origin of matter

6.16 Tatsuma Nishioka (The University of Tokyo) : Holographic Superconductor/Insulator Transition at Zero Temperature

6.16 Takashi Imamura (RCAST, the Univ. of Tokyo) : Double occupancy probability in the Anderson model: an approach based on many-electron scattering states

6.23 Takeshi Fukuyama (Ritsumeikan University) : SO(10) GUT in 5D

6.23 Mari Matsuo (Japan Atomic Energy Agency) : Nernst effect and Seebeck effect

6.28 Koshi Takenaka (Nagoya University) : Magnetostructural Correlations in Antiperovskite Manganese Nitrides

7.5 Tatsuya MORI (Institute for Molecular Science) : Terahertz time-domain spectroscopy of rattling phonons in type-I clathrates

7.5 Pablo Cerda Duran (Max Planck Institute) : Hydromagnetic instabilities and magnetic field amplification in core collapse supernovae

7.7 Arjen van Vliet (Kernfysisch Versneller Instituut, University of Groningen) : The UHE Neutrino spectrum and the LPM effect

7.8 Hiroshi Eisaki (AIST) : Recent topics on the research activities of iron-based superconductors at AIST (1) High pressure synthesis and properties of oxygen-deficient oxypnictide superconductors LnFeAsO1-y (2) In-plane anisotropy of the BaFe2As2

7.12 Yasuhiro Utsumi (Faculty of engineering, Mie University) : Quantum fluctuation theorem in a two-terminal Aharonov-Bohm interferometer

7.14 Masanobu Yahiro (Department of Physics, Kyushu University) : Holographic and effective model approaches to QCD

7.14-15 Yahiro Masanobu (Department of Physics, Kyushu University) : Lecture Series: Holographic model of hadrons

7.16 Akihiro Nishiyama (YITP) : Entropy Production of Quantum Fields with Kadanoff-Baym approach

7.21 Emiko Hiyama (RIKEN) : Five-body cluster structure of double-Λ hypernucleus ${}^{11}_{\Lambda\Lambda}$Be

7.21 Jun Ohkubo (Graduate School of Informatics, Kyoto University) : Noncyclic and nonadiabatic geometric phase for counting statistics

7.22 Keiichi Maeda (IPMU, The University of Tokyo) : Toward a Unified Picture of Type Ia Supernovae

7.23 Takenori Furumoto (YITP, Kyoto Univ.) : Microscopic optical potential with complex G-matrix interaction

7.26 Naoyuki Itagaki (YITP) : YITP Colloquium: Specific structure of light neutron-rich nuclei

7.27 Ferenc Kun (University of Debrecen) : Universality classes of fragmentation phenomena

7.27 Shigeki Sugimoto (IPMU) : Hadrons in Holographic QCD (review)

7.28 Kohei Kamada (Research Center for the Early Universe, Univ. of Tokyo) : GCOE/YITP Seminar:Thermal effect on the Q-balls and gravitational waves

8.5 Zohar Komargodski (Institute for Advanced Study, Princeton) : Exactly Marginal Deformations and Global Symmetries

8.5 Dominikus Heinzeller (Department of Astronomy, Graduate School of Science, Kyoto University) : CEPD - Chemical Evolution of Protoplanetary Disks

8.18 Kohkichi Konno (Tomakomai National College of Technology) : Rotating black hole in Chern-Simons theory of gravity

9.1 Andrea Vitturi (INFN, Padova, Italy) : Dipole Pygmy Resonance in very-neutron rich nuclei and its excitation via nuclear and Coulomb fields

9.3 N. L. Saini (The Univ. of Tokyo/Universita di Roma) : Local atomic disorder and inhomogeneities : from the cuprates to the Fe-based superconductors

9.7 Nic Shannon (H H Wills Physics, University of Bristol) : Are Fe pnictides frustrated magnets ?

9.7 Muneto Nitta (Keio University) : Non-Abelian Vortices in Dense QCD.

9.7 Giacomo Marmorini (Keio University) : Exact Self-Consistent Condensates in (Imbalanced) Superfluid Fermi Gases

9.15 Anne Taormina (University of Durham) : Symmetries of K3 lattices in the Mathieu group $M_2 4$

9.16 Jinn-Ouk Gong (Leiden University, Leiden) : Loop corrections to the correlation functions of cosmological perturbations

9.29 Shotaro Shiba (KEK) : Analysis of correlation functions in Toda theory and AGT-W relation

9.29 Takeru Okada (Institute of Multidisciplinary Research for Advanced Materials, Tohoku Univ.) : Diffusional motion analysis of carbon nanotubes in solution

9.30-10.1 Masatoshi Sato (The University of Tokyo, The Institute for Solid State Physics) : Lecture Series:Recent topics on topological superconductors

10.4 Fabio Iocco (Institut d'Astrophysique de Paris) : Pamela, Fermi: Cosmic Ray 'eccesses', where do we stand today?

10.4 Kuniyasu Saitoh (YITP, Kyoto University) : Weakly nonlinear analysis of granular shear flow

10.4 Esteban Roulet (Centro Atomico Bariloche, Argentina) : Ultra-high energy cosmic rays and the Pierre Auger Observatory

10.6 Federico Urban (University of British Columbia) : The QCD nature of Dark Energy, signatures and applications

10.12 Oleg P. Sushkov (University of New South Wales) : Spin spirals in underdoped cuprates: theory and experiment

10.13 Kiyoshi Hayasaka (Nagoya Univ.) : Recent results for tau decays from Belle - tau LFV decays

10.13 Cyril Pitrou (ICG, University of Portsmouth) : The non-linear evolution of the cosmic microwave background: non-Gaussianity and spectral distortions

10.13 Natasha Kirova (LPS, CNRS & Universite Paris-Sud, Orsay, France) : Conjugated polymers at the verge of strongly correlated systems and 1D semiconductors

10.13 Hiroyuki Ebata (The Univ. of Tokyo) : Dynamics of deformed holes in vertically vibrated dense suspensions

10.19 Janez Bonca (University of Ljubljana and Josef Stephan Institute) : Gain of the kinetic energy of bipolarons in the t-J-Holstein model based on electron-phonon coupling

10.20 Cristiano Germani (ASC, University of Munich) : New Higgs Inflation

10.22 Kenichi Yoshida (RIKEN) : Skyrme energy-density functional approach to collective excitations in medium-mass to heavy nuclei

10.25 Michael Kroyter (Tel-Aviv University) : GCOE/YITP Seminar:Lattice string field theory

10.25 Anders W. Sandvik (Boston University) : Deconfined spinons at the Neel-VBS transition in two dimensions

10.27 Masayuki Ohzeki (Graduate School of Informatics, Kyoto University) : Nonequilibrium Relations for Spin Glasses with Gauge Symmetry

10.27-28 Tadashi Takayanagi (IPMU, the Univ. of Tokyo) : Lecture Series:AdS/CFT from the viewpoint of condensed matter physics

10.29 Makoto Natsuume (KEK) : Critical phenomena in AdS/CFT duality

11.1 Loriano Bonora (SISSA) : YITP Colloquium: The origin of non-abelian symmetries in field theory: a string theory point of view

11.10 Yoichi Kazama (Institute of Physics, University of Tokyo) : Green-Schwarz Superstring in Semi-Light-Cone Conformal

Gauge

11.15 Guido Chincarini (Brera Astronomical Observatory, Italy) : Variability and Flares in the Gamma Ray Bursts (GRBs) light curve: What are they telling us about the emission mechanism and the central engine.

11.17 Muneto Nitta (Keio University) : Topological Excitations and D-branes in Bose-Einstein Condensates

11.17 Frank Pollmann (University of California, Berkeley and Academia Sinica, Taiwan) : Symmetry protected topological phases: An entanglement point of view

11.19 Kazuyuki Ogata (Kyushu Univ.) : Quantum scattering of three particles in stars: new understanding of the formation of ^{12}C

11.22 Tohru Sakai (Japan Atomic Energy Agency) : Exotic Quantum Phase Transitions in the Spin Nanotube

11.25 Takami Kuroda (The Univ. of Tokyo) : Three dimensional MHD simulations of gravitational collapse of massive stars

11.25 Janez Bonca (University of Ljubljana and Josef Stephan Institute) : Numerical study of many-body systems, driven by a constant electric field

11.29 Peter Schuck (Orsay, France) : GCOE/YITP Seminar : General Many Body Theory for alpha Particle (quartet) condensation in the macroscopic Limit.

11.29 Serguei Brazovskii (LPTMS-CNRS, University Paris-Sud, Orsay, France) : YITP Colloquium: Nonequilibrium coherent dynamics in Charge Density Waves from femto-second optical experiments and their modeling

11.30 Marco Cosentino Lagomarsino (Universite Pierre et Marie Curie, Centre de recherche des Cordeliers) : A model-system approach to biological fluid pumping

12.1 Hajime Aoki (Saga University) : Ginsparg-Wilson relation on a fuzzy 2-sphere with adjoint matter

12.1 Akira Mizuta (KEK) : Photospheric thermal radiation from collapsar jets

12.1 Jean-Marc Levy-Leblond (the Universite de Nice) : Some questions about time

12.1 Frieder Lenz (Institute for Theoretical Physics III, University of Erlangen-Nurnberg, Germany) : The peculiar kinematics of quantum fields in Rindler space and their dynamical implications

12.6 Takahiko Matsubara (Nagoya Univ.) : Perturbation theory and biasing in the large-scale structure of the universe

12.6-7 Takahiko Matsubara (Nagoya Univ.) : Lecture Series:The large-scale structure of the universe and cosmology

12.8 Naonori Sugiyama (Tohoku University Astronomical Institute) : Non-Gaussianity consistency relation: extension of Suyama Yamaguchi inequality

12.13 Sergey Ketov (Tokyo Metropolitan University) : Supergravity and Early Universe Cosmology

12.15 Takuya Okuda (The University of Tokyo) : Localization, 't Hooft loops and the Bogomolny equation

12.15 Kuniyasu Saitoh (YITP, Kyoto University) : Numerical study of oblique impact of nanoclusters

12.15-16 Sinya Aoki (Univ. of Tsukuba) : Lecture Series:Introduction to lattice QCD for non-experts: from the viewpoint of numerical simulations

12.16 Denis Allard (Laboratoire Astroparticules et Cosmologie (APC)) : Implication of UHE cosmic-ray nuclei propagation on the spectrum and composition

12.16 Kumiko Kotera (University of Chicago) : A quest for sources of ultrahigh energy cosmic rays

12.17 David R. Morrison (UC, Santa Barbara) : K3 surfaces, modular forms, and non-geometric heterotic compactifications

12.21 Yoritaka Iwata (Extreme Matter Institute, GSI Helmholtz Center, Germany) : Role of the tensor force in collision dynamics

12.22 Yuya Sasai (University of Helsinki) : Shear viscosity of a highly excited string and black hole membrane paradigm

12.22 Ayumu Sugita (Osaka city Univ.) : Perturbative Analysis of Nonequilibrium Steady States in Quantum Systems

12.24 Aurelien Benoit-Levy (Institut d'Astrophysique de Paris) : Aspects of CMB lensing

1.7 Futoshi Yagi (IHES) : Generalized matrix models and AGT correspondence at all genera

1.12 Shinya Kanemura (University of Toyama)

: Electroweak Symmetry Breaking and Terascale Physics

1.19 Jan Manschot (CEA Saclay) : Wall-crossing from Boltzmann black hole halos

1.26-27 Kiyoshi Kato (Hokkaido Univ.): Lecture Series : Many-body resonance states using complex scaling method

1.27 Kin-ya Oda (Osaka Univ.) : Unitarity in Dirichlet Higgs Model

2.2 Goro Ishiki (CQUeST, Sogang University) : Boundary operators in matrix models

2.7 Atsushi Nakamura (Information Media Center Hiroshima University) : Lattice QCD at Finite Density with Wilson Fermions

2.7-8 Atsushi Nakamura (Information Media Center Hiroshima University): Lecture Series:Introduction to Lattice QCD at Extreme Conditions

2.8 Hidekazu Tanaka (Hokkaido University, Institute of Low) : Molecular Dynamics Simulation of Mechanical Interaction between Sub-micron Spherical Particles

2.9 Hide Sakaguchi (JAMSTEC) : Granular Convection in Spherical Shell

2.15 Kyung-il Kim (Yonsei University, Korea) : A QCD sum rule approach with a explicit diquark field

3.1 Yuki Nagai (CCSE, Japan Atomic Energy Agency) : Pairing state in iron pnictide superconductor : theoretical studies for the impurity effects and the neutron scattering resonance

3.2 Ryo Suzuki (Utrecht University) : Hybrid NLIE for the Mirror AdS_5xS^5

3.2 Hiroya Nakano (Kyoto Univ.) : Phase reduction approach to periodic solutions in reaction-diffusion systems

3.8-9 Hajime Susa (Konan Univ.) : Lecture Series: Formation of first generation objects at the end of the dark ages

3.9 Hajime Susa (Konan Univ.) : Dissipation of magnetic field in low metal prestellar core

3.9 Takeshi Matsumoto (Kyoto Univ.) : Density-difference driven turbulence: Rayleigh-Taylor turbulence

3.10 Clement Sire (Laboratory of Theoretical Physics, CNRS & University of Toulouse) : Collapse dynamics of a self-gravitating Brownian gas

3.11 Jumpei Takata (The Univ. of Hong Kong) : Photon-splitting and X-ray emissions in magnetar models

3.14 Atsuo Okazaki (Hokkai-Gakuen University) : Accretion and colliding-wind simulations of TeV gamma-ray binaries

3.16 Binata Panda (Institute of Physics) : GUT particle spectrum and Interactions in Magnetized Branes

3.16 Yu Itino (Kyoto University) : Collective Dynamics of Deformable Self-Propelled Particles

3.18 Robert Crittenden (ICG, Portsmouth University) : YITP Colloquium: Making the most of maps of the Universe

3.23 Imtak Jeon (Sogang University) : Differential geometry from string theory

3.23 Marco Ruggieri (YITP) : The Color-Flavor-Locking phase of High Density QCD

3.28 Shigenori Matsumoto (Tokyo Univ.) : New Approaches to Study of Group Behaviors for Granular to Intelligent Particle.

3.30 Takeo Inami (Chuo Univ.) : Inflaton from higher dimensional gauge theory

2.5 Visitors (2009)

Visitors

Moriyama, Sanefumi (E)
Nagoya University
2010.04.01 — 2011.03.31
Weinstein, Marvin (E)
SLAC
2010.04.05 — 2010.04.12
Prudenziati, Andrea (E)
S.I.S.S.A./I.S.A.S.
2010.04.13 — 2010.04.16
Cai, Yi-fu (A)
IHEP, Chinese Academy of Sciences
2010.04.16 — 2010.04.21
Montero, Pedro (A)
Max Planck Institute for astrophysics
2010.04.19 — 2010.04.26
Sahu, Sarira (A)
Universidad Nacional Autonoma de Mexico
2010.04.24 — 2010.05.01
Keum, Yong-Yeon (A)
Ewha Womans University
2010.04.24 — 2010.05.01
von Gehlen, Guenter (E)
Bonn Univ.
2010.04.26 — 2010.05.04
Penc, Karlo (C)
RISSP, Budapest
2010.05.10 — 2010.05.13
Read, Jocelyn (A)
Albert-Einstein Institute
2010.05.12 — 2010.05.16
Ni, Wei-Tou (A)
National Tsing Hua Univ.
2010.05.12 — 2010.05.19
Lerche, Wolfgang (E)
CERN
2010.05.16 — 2010.05.19
Balog, Janos (E)
KFKI Research Institute
2010.05.24 — 2010.05.26
van Vliet, Arjen (A)
University of Groningen
2010.06.01 — 2010.11.30
Ito, Hirotaka (A)
Tohoku Univ.
2010.06.03 — 2010.06.05
Raha, Udit (N)
National Taiwan Univ.
2010.06.07 — 2010.06.11
Duran, Pablo Cerda (A)
Max Planck Institute
2010.07.04 — 2010.07.06
Park, Wan-Il (A)
KAIST
2010.07.19 — 2010.08.02
Emiko Hiyama (N)
RIKEN
2010.07.20 — 2010.07.22
Kamada, Kouhei (E)
University of Tokyo
2010.07.20 — 2010.07.29
Lee, Sungjay (C)
Korea Institute for Advanced Study
2010.07.21 — 2010.07.28
Hasebe, Kazuki (C)
Kagawa National College of Technology
2010.07.24 — 2010.08.04
Park, Jaemo (E)
POSTECH
2010.07.26 — 2010.07.29
Oset, Eulogio (N)
Univ. of Valencia
2010.07.31 — 2010.08.27
Komargodski, Zohar (E)
Institute for Advanced Study, Princeton
2010.08.04 — 2010.08.12
Petruccione, Francesco (C)
University of KwaZulu-Natal
2010.08.06 — 2010.09.04
Molina, Raquel (N)
Univ. of Valencia
2010.08.08 — 2010.08.27
Garzon, Javier (N)
Univ. of Valencia
2010.08.16 — 2010.08.29
Konno, Kohkichi (A)
Tomakomai National College of Technology

2010.08.17 — 2010.08.19
Ansoldi, Stefano (A)
Universita‘ degli Studi di Udine
2010.08.18 — 2010.08.29
Xu, Ming (A)
Nanjing Univ.
2010.08.20 — 2010.11.18
Yamawaki, Koichi (E)
Nagoya University
2010.08.30 — 2010.09.01
Prokhorov, Dmitry (A)
KASI
2010.08.30 — 2010.09.05
Saini, Naurang (C)
The Univ. of Tokyo/Universita di Roma La Sapienza
2010.09.02 – 2010.09.04
Shannon, Nic (C)
University of Bristol
2010.09.05 — 2010.09.07
Nitta, Muneto (N)
Keio Univ.
2010.09.06 — 2010.09.08
Marmorini, Giacomo (N)
KeioUniv.
2010.09.06 — 2010.09.08
Taormina, Anne (E)
University of Durham
2010.09.06 — 2010.09.19
Hikami, Kazuhiro (E)
Naruto University of Education
2010.09.09 — 2010.09.10
Gong, Jinn-Ouk (A)
Leiden University, Leiden
2010.09.13 — 2010.09.26
Crittenden, Robert (A)
ICG, Univ.of Portsmouth
2010.09.15 — 2010.09.20
Hwang, Jai-chan (A)
Kyungpook National University
2010.09.21 — 2010.09.25
Shiba, Shotaro (E)
KEK
2010.09.28 — 2010.09.29
Yasui, Shigehiro (N)
KEK
2010.09.29 — 2010.10.01
Sato, Masatoshi (C)
The University of Tokyo, The Institute for Solid State Physics
2010.09.29 — 2010.10.01
Kirova, Nathalie (C)
University Paris-Sud
2010.10.01 — 2010.12.31
Roulet, Esteban (A)
Centro Atomico Bariloche, Argentina
2010.10.03 — 2010.10.05
Iocco, Fabio (A)
Institut d’Astrophysique de Paris
2010.10.03 — 2010.10.06
Keum, Youg Yeon (A)
IEU, Ewha Womans University
2010.10.03 — 2010.10.17
Urban, Federico (E)
Univ. of British Columbia
2010.10.05 — 2010.10.09
Sushkov, Oleg P. (C)
The University of New South Wales
2010.10.09 — 2010.12.11
Yokoyama, Shuuichi (E)
University of Tokyo
2010.10.11 — 2010.11.07
Kroyter, Michael (E)
Tel-Aviv University
2010.10.14 — 2010.10.28
Bonca, Janez (C)
University of Ljubljana
2010.10.18 — 2010.10.20
Germani, Cristiano (A)
ASC, University of Munich
2010.10.18 — 2010.10.23
Vidmar, Lev (C)
Jozef Stefan Institute
2010.10.24 — 2010.12.06
Sandvik, Anders (C)
Boston University
2010.10.25 — 2010.10.30
Abolhasani, Ali Akbar (A)
Sharif Univ. of Technology
2010.10.25 — 2011.01.21
Takayanagi, Tadashi (E)
IPMU, the Univ. of Tokyo
2010.10.27 — 2010.10.29
Bang, Yun Kyu (C)
Chonnam National University
2010.11.03 — 2010.11.06
Chincarini, Guido (A)
Brera Astronomical Observatory, Italy
2010.11.14 — 2010.11.19
Nitta, Muneto (E)
Keio Univ.
2010.11.16 — 2010.11.18

Park, Jaemo (A)
POSTECH
2010.11.17 — 2010.11.27
Deruelle, Nathalie (A)
APC, IHES
2010.11.23 — 2010.12.21
Takamizu, Yuichi (A)
RESCEU, Univ.of Tokyo
2010.11.24 — 2010.11.26
Bonca, Janez (C)
Ljubljana University
2010.11.25 — 2010.11.27
Schuck, Peter (N)
University of Paris-Sud 11 (Orsay)
2010.11.28 — 2010.12.03
Lagomarsino, Marco Cosentino (C)
Universite Pierre et Marie Curie, Centre de recherche des Cordeliers
2010.11.29 — 2010.11.30
Lenz, Frieder (N)
University of Erlangen-Nürnberg
2010.12.01 — 2010.12.03
Sendouda, Yuuichi (A)
Hirosaki University
2010.12.03 — 2010.12.05
Sugiyama, Naonori (A)
Tohoku University Astronomical Institute
2010.12.05 — 2010.12.09
Matsubara, Takahiko (A)
Nagoya Univ.
2010.12.06 — 2010.12.07
De Felice, Antonio (A)
Tokyo Univ.of Science
2010.12.12 — 2010.12.18
Allard, Denis (A)
APC, University Paris 7
2010.12.12 — 2010.12.23
Kotera, Kumiko (A)
University of Chicago
2010.12.13 — 2010.12.26
Koyama, Kazuya (A)
Univ. of Portsmouth
2010.12.14 — 2010.12.17
Morrison, David R. (E)
University of California, Santa Barbara
2010.12.14 — 2010.12.18
Aoki, Shinya (A)
Univ. of Tsukuba
2010.12.15 — 2010.12.16
Sendouda, Yuuichi (A)
Hirosaki University
2010.12.16 — 2010.12.22
Benoit-Le'vy, Aure'lien (A)
Institut d'Astrophysique de Paris
2010.12.17 — 2010.12.25
Yamagata-Sekihara, Junko (N)
IFIC, Valencia Univ.
2010.12.21 — 2011.02.28
Yuya Sasai (E)
University of Helsinki
2010.12.22 — 2011.01.14
Kuninaka, Hiroto (C)
Mie University
2010.12.24 — 2010.12.25
Tachikawa, Yuji (E)
IPMU
2011.01.06 — 2011.01.07
Möller, Peter (N)
Los Alamos National Laboratory
2011.01.09 — 2011.01.15
Li, Zhi (C)
RIKEN
2011.01.11 — 2011.01.12
Owocki, Stanley P. (A)
University of Delaware
2011.01.15 — 2011.01.21
Okazaki, Atsuo (A)
Hokkai-Gakuen University
2011.01.16 — 2011.01.20
Otsuki, Michio (C)
Aoyama Gakuin University
2011.01.17 — 2011.01.18
Arroja, Frederico (A)
Ewha Womans University
2011.01.18 — 2011.02.02
Kun, Ferenc (C)
Univ. of Debrecen
2011.01.20 — 2011.01.25
Kato, Kiyoshi (N)
Hokkaido Univ.
2011.01.25 — 2011.01.27
Kohri, Kazunori (A)
KEK
2011.01.30 — 2011.02.02
Nakamura, Atsushi (N)
Information Media Center Hiroshima University
2011.02.06 — 2011.02.08
KIM, Kyung-il (N)
Yonsei University
2011.02.14 — 2011.02.19

Suyama, Teruaki (A)
RESCEU, Univ.of Tokyo
2010.12.15 — 2010.12.18
Takami, Hajime (A)
Max Planck for Physics
2010.12.15 — 2010.12.23
Li, Zhi (C)
RIKEN
2011.02.24 — 2011.02.26
Kaneshita, Eiji (C)
Sendai National College of Technology
2011.02.28 — 2011.03.02
Tsutsui, Kenji (C)
JAEA
2011.02.28 — 2011.03.02
Tachibana, Motoi (E)
Saga University
2011.03.01 — 2011.03.03
Suzuki, Ryo (E)
Utrecht Univ.
2011.03.01 — 2011.03.04
Steinacker, Harold (E)
Universita”t Wien
2011.03.01 — 2011.03.05
Maruhn, Joachim A. (N)
Frankfurt University
2011.03.01 — 2011.03.31
Susa, Hajime (A)
Konan Univ.
2011.03.08 — 2011.03.09
Kawachi, Akiko (A)
Tokai University
2011.03.10 — 2011.03.13
Naito, Tsuguya (A)
Yamanashi Gakuin University
2011.03.10 — 2011.03.14
Okazaki, Atsuo (A)
Hokkai-Gakuen University
2011.03.10 — 2011.03.15
Takata, Jumpei (A)
The Univ. of Hong Kong
2011.03.10 — 2011.03.15
Panda, Binata (E)
Institute of Physics
2011.03.14 — 2011.03.18
Starobinskiy, Alexey (E)
Landau Institute/RESCEU
2011.03.14 — 2011.03.23
Crittenden, Robert (A)
ICG, Univ. of Portsmouth
2011.03.14 — 2011.03.30
Matsumoto, Shigenori (C)
Univ. of Tokyo
2011.03.16 — 2011.03.31
Asano, Masaki (E)
Tohoku University
2011.03.18 — 2011.03.25
Kitano, Ryuichiro (E)
Tohoku University
2011.03.18 — 2011.03.28
Jeon, Imtak (E)
Sogang Univ.
2011.03.23 — 2011.03.24

In the above lists, the symbols A, C, E and N in the parentheses are thefollowing abbreviations of research fields:

A: Astrophysics and Cosmology
C: Condensed Matter and Statistical Physics
E: Elementary Particle Theory
N: Nuclear Physics Theory

Chapter 3

Workshops and Conferences

3.1 International Workshops and Conferences

Since 1978, a series of international physics workshops, called *Yukawa International Seminar (YKIS)* are held annually or bi-annually. *The Nishinomiya Yukawa Memorial Project* was initiated by Nishinomiya city where the late Prof. Hideki Yukawa lived when he wrote his famous papers on the meson theory. As one of the major programs of this project, an international symposium open to public was held every year in Nishinomiya city, and its post/pre-workshop held at YITP. In recent years both the Nishinomiya Yukawa Symposium and its post/pre-workshops are held at YITP, Kyoto.

As of the academic year 2007, Yukawa Institute for Theoretical Physics launched a new five-year project, "*Yukawa International Program for Quark-Hadron Sciences* (YIPQS)." A few research topics are selected each year and a long-term workshop focused on each topic, extending over a period of a few months, is organized by inviting leading experts from the world. Emphasis is laid on fostering fruitful collaboration among the workshop participants. See page 21 for details.

In addition to these regular annual conferences, many international workshops and conferences of various sizes and durations from several days to more than one month are held every year.

Here is a list of main international workshops and conferences held in the academic year 2009.

Yukawa International Seminar (YKIS2010)

YKIS2010 : Cosmology - the Next Generation -
Jun 28 - Jul 2, 2010, Chaired by Misao Sasaki, 144 participants (57 from abroad)
For details, see http://www2.yukawa.kyoto-u.ac.jp/ ykis2010/index.html

Nishinomiya-Yukawa Symposium 2010

High Energy Strong Interactions 2010 - Parton Distributions and Dense QCD Matter
Jul 26 - Aug 27, 2010, Chaired by Kenji Fukushima, 113 participants (50 from abroad)
For details, see http://www2.yukawa.kyoto-u.ac.jp/ hesi10/

3.2 YITP Workshops

YITP workshops are one of the main activities of Yukawa Institute. The aim of th2em is to open new research fields and stimulate nationwide collaborations. Workshop plans can be proposed by any researcher and are approved by the Committee on Research Projects of the Institute. Small workshops, summer schools and regional schools to educate young researchers are positively supported.
In the past 5 years, more than 20 workshops are held each year with 1500 strong participants visiting YITP. The list of the workshops together with the number of participants for the last academic year is given below.

▷ 2009.4.1 — 2010.3.31

Here is the list of workshops with the dates, the names of organizers, the number of participants, the proceedings and the url's.

YITP-W-10-01
Deciphering the Ancient Universe with Gamma-Ray Bursts, Apr 19 -23, 2010. Y. Yatsu, M. Yoshida, M. Iye, T. Nakamura, J. Watanabe, K. Nomoto, T. Murakami, K. Sato, T. Totani, S. Nagataki, A. Yoshida, K. Ohta, Ts. Terasawa, K. Ioka, R. Yamazaki, N. Kawai, S. Inoue, D. Yonetoku, *160-participants,*
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2010/yitp-w-10-01/

YITP-W-10-02
Field theory and string theory, Jul 20 - 24, 2010. H. Kunitomo, M. Kato, N. Ohta, T. Sakai, S. Sugimoto, M. Sakaoto, S. Terashima, K. Hashimoto, M. Hamanaka, S. Moriyama, T. Takayanagi, K. Yoshida, Y. Imamura, *151-participants,*
http://www2.yukawa.kyoto-u.ac.jp/ qft/

YITP-W-10-03
Summer School on Astronomy and Astrophysics 2010, Aug 2 - 5, 2010. K. Tomita, R. Ishikawa, Y. Sakata, T. Nakamura, K. Hata, N. Ienaka, H. Ito, R. Momose, T. Shibuya, H. Makitsubo, *389-participants,*
http://www.astro-wakate.org/ss2010/

YITP-W-10-04
Statistical physics and topology of polymers with ramifications to structure and function of DNA and proteins, Aug 2 - 6, 2010. K. Tsurusaki, H. Hayakawa, K. Shimokawa, A. Stasiak, T. Deguchi, *59-participants,*
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2010/yitp-w-10-04

YITP-W-10-05
Young Nuclear and Particle Physist Group of Japan, Aug 5 - 10, 2010. Y. Nakagawa, S. Yusa, N. Watanabe, M. Izaka, Y. Aida, S. Torii, T. Sakaeda, N. Fukui, T. Nakano, T. Yamaoka, Y. Arita, *219-participants,*
http://www-hep.phys.se.tmu.ac.jp/yonupa2010/index.html

YITP-W-10-06
The 55th Condensed-Matter Physics Summer School, Aug 7 - 11, 2010. K. Ishimoto, T. Higuchi, E. Iyoda, S. Takayoshi, K. Shigiya, T. Kimura, Y. Motoyama, K. Kanaiwa, R. Masumoto, T. Akiyama, M. Yamamoto, A. Shimode, S. Yoshimoto, H. Akagi, K. Saito, *210-participants,*
http://cmpss.jp/

YITP-W-10-07
Summer Institute 2010 on Particle Physics Phenomenology, Aug 12 - 19, 2010. H. Nakano, M. Bando, K. Choi, H. Terao, T. Kobayashi, M. Tanimoto, J. Kubo, T. Asaka, T. Kugo, M. Yamaguchi, K. Hamaguchi, T. Kurimoto, *70-participants,*
http://muse.sc.niigata-u.ac.jp/SI2010/index-e.html

YITP-W-10-08
Thermal Quantum Field Theory and Their Applications, Aug 30 - Sep 1, 2010. S. Muroya, M. Mine, K. Iida, M. Okumura, S. Abe, A. Ohnishi, M. Asakawa, S. Ejiri, T. Inagaki, M. Sakagami, M. Tachibana, C. Nonaka, *97-participants,*
http://www.riise.hiroshima-u.ac.jp/TQFT/

YITP-W-10-09
Microscopic theory of large-amplitude collective motion , Oct 24 - 26, 2010.

M. Matsuo, K. Hagino, T. Ichikawa, N. Hinohara, *36-participants,*
http://www2.yukawa.kyoto-u.ac.jp/ lacm10/

YITP-W-10-10
The 20th workshop on General Relativity and Gravitation in Japan (JGRG20), Sep 21 - 25, 2010. M. Shibata, T. Tanaka, J. Soda, S. Mukohyama, T. Shuromizu, M. Sasaki, M. Yamaguchi, T. Harada, H. Kodama, K. Maeda, K. Ioka, K. Nakao, T. Nakamura, H. Ishihara, K. Oohara, Y. Kojima, H. Asada, J. Yokoyama, T. Chiba, N. Seto, *170-participants,*
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2010/yitp-w-10-10/

YITP-W-10-11
Discretization approaches to the dynamics of space-time and fields, Sep 27 - Oct 1, 2010. H. Fuji, T. Asakawa, N. Kawamoto, N. Sasakura, H. Suzuki, A. Tsuchiya, Y. Watabiki, S. Watamura, J. Nishimura, *34-participants,*
http://www2.yukawa.kyoto-u.ac.jp/ sasakura/risan/risan.htm

YITP-W-10-12
International and Interdisciplinary Workshop on Novel Phenomena in Integrated Complex Sciences: from Non-living to Living Systems, Oct 11 - 14, 2010. K. Yoshimura, M. Murase, K. Nishimura, J. Haase, M. Fang, N. Curro, M. Takigawa, H. Nakamura, K. Ishida, H. Sugiyama, S. Kambe, *71-participants,*
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2010/yitp-w-10-12/

YITP-W-10-13
String Field Theory and Related Aspects, Oct 18 - 22, 2010. I. Ya Arefeva, T. Kugo, H. Hata, I. Kishimoto, H. Kunitomo, N. Moeller, M. Schnabl, Y. Okawa, T. Takahashi, *57-participants,*
http://asuka.phys.nara-wu.ac.jp/sft10/

YITP-W-10-14
Duality and Scales in Quantum-Theoretical Sciences, Nov 4 - 6, 2010. R. Sasaki, I. Tsutsui, H. Hayakawa, Y. Shikano, S. Tanimura, M. Morikawa, I. Ojima, A. Hosoya, M. Hotta, *85-participants,*
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2010/yitp-w-10-14/

YITP-W-10-15
New Development of Numerical Simulations in Low-Dimensional Quantum Systems : From Density Matrix Renormalization Group to Tensor Network Formulations, Oct 27 - 29, 2010. T. Tohyama, K. Okunishi, M. Machida, H. Matsueda, N. Shibata, T. Hikihara, K. Totsuka, K. Harada, T. Nishino, *67-participants,*
http://www2.yukawa.kyoto-u.ac.jp/ dmrg/

YITP-W-10-16
Physics of Nonequilibrium Systems - Fluctuation and Collective Behavior -, Nov 18 - 20, 2010. M. Sano, H. Hayakawa, H. Kitahata, H. Tasaki, H. Wada, K. Saito, *140-participants,*
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2010/yitp-w-10-16/

YITP-W-10-17
Progress in Particle Physics 2011, Mar 7 - 10, 2011. K. Oda, R. Kitano, J. Sato, K. Tobe, K. Hamaguchi, S. Matsumoto and K. Yoshioka, *122-participants,*
http://www2.yukawa.kyoto-u.ac.jp/ ppp/

YITP-W-10-18
International school of numerical relativity and graviational waves, Jul 26 - 30, 2010. G. Kang, M. Shibata, *66-participants,*
http://apctp.org/conferences/2010/NRG2010/

YITP-W-10-19
50th Summer School for the Organization of Young Biophysicists, Sep 3 - 6, 2010. T. Tsuduki, K. Katayama, Y. Mori, K. Yamada, K. Tanaka, R. Urano, K. Yamada, S. Kushima, S. Ozaki, T. Anzai, T. Yamada, L. Negishi, *89-participants,*
http://www.bpwakate.net/summer/

YITP-W-10-20
Recent Progress in Physics of Dissipative Particles - From fine powders to macroscopic behaviors of granular particles -, Nov 24 - 26, 2010. K. Saitoh, *50-*

participants,
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2010/yitp-w-10-20/

YITP-W-10-21
Professor Chushiro Hayashi and Astronomy, Astrophysics, Dec 20 - 22, 2010. F. Sato, S. Miyama, N. Gouda, K. Wada, M. Sasaki, M. Shibata, T. Tanaka, T. Shiromizu, K. Omukai, T. Muranushi, Y.Sawa, *195-participants,*
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2010/yitp-w-10-21/

YITP-W-10-22
Electroweak Symmetry Breaking, Mar 11 - 17, 2011. R. Kitano, M. Asano, K. Hikasa, M. Yamaguchi, F. Takayama, *39-participants,*
http://www.tuhep.phys.tohoku.ac.jp/kiken_workshop2011/

YITP-W-10-23
Lecture for the new YITP computer system (SR16000), Feb 8 - 9, 2011. F. Takayama, *62-participants,*
http://www.yukawa.kyoto-u.ac.jp/computer1/keisanki/machine10.pdf

3.3 Regional Schools supported by YITP

▷ 2010.4.1—2011.3.31

Here is the list of the Regional Schools with the dates, the place, the name(s) of the main invited Lecturer(s) and the participating Universities.

YITP-S-10-01
The 38th Hokuriku-Shinetsu Particle Physics Theory Group Meeting , May 21 - 23, 2010, National Noto Youth Friendship Center.
D. Suematsu

YITP-S-10-02
Chubu Summer School 2010, Aug 22 - 25, 2010, Yamanakako Seminar House, Tokai Univesity.
S. Ichinose

YITP-S-10-03
23th Workshop in Hokkaido Nuclear Theory Group, Oct 9 - 12, 2010, Kitami Institute of Technology.
T. Katayama

YITP-S-10-04
The 15th Niigata-Yamagata School, Nov 19 - 21, 2010, National Youth Exchange House in Bandai.
S. Ejiri

YITP-S-10-05
33rd Shikoku Seminar, Dec 25 - 26, 2010, Tokushima University.
Z. Hioki

YITP-S-10-06
Shinshu Winter School, Mar 10 - 13, 2011, Shiga Heights Villa, Ochanomizu University.
Y. Kawamura